Railway Mechanical Engineer

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Only a sufficient number of indexes for Volume 97 of the *Railway Mechanical Engineer,* which closed with the December issue, will be printed to supply the number of copies specially requested by our subscribers. If you wish to have a copy, order it now, as the order for printing will soon be made up. Address your request to our New York office, 30 Church street.

Winners in Engine Terminal Competition

In our August and September issues, we announced an offer of two prizes of $50 and $35, respectively, for the two best papers on the most constructive suggestions for expediting locomotive movements through the terminal, simplifying inspection repairs and keeping engine failures down during traffic peaks. The first prize has been awarded to E. Gelzer. Mr. Gelzer, at the time he entered the competition, was employed as a locomotive designer by the Illinois Central. He has recently been appointed mechanical engineer of the Chicago, Great Western, an announcement of which appears in the Personal news columns in this issue. He was at one time a roundhouse foreman on the Pennsylvania System, so that his paper is based on practical experience. The second prize winner is F. M. Podruch, roundhouse foreman of the Chicago, St. Paul, Minneapolis & Omaha at Elroy, Wis. The prize-winning articles will appear in early issues.

A Competition—How Do You Prevent Hot Boxes?

Hot boxes constitute one of the most troublesome conditions with which car department officers and foremen have to deal. The service may be running along smoothly with only an occasional delay chargeable to this cause when suddenly it seems as though every car on the road has become infected and, almost without warning, an epidemic is in progress. These epidemics are frequently very difficult to bring under control and a large amount of special attention is devoted to the situation in an effort to discover just which one of several mechanical or human conditions is at fault. Usually the practice adopted as a result of such special studies, which finally cures the epidemic, aims at a tightening up in several of these conditions, all of which, it may be concluded, were contributory. These epidemics suggest that the problem is one not only of finding the causes which are active in these particular cases, but of maintaining permanently the conditions which prevent the causes from arising. If the conditions are mechanical, how can the repair or renewal of the critical parts be insured at the proper time to prevent these destructive accumulations of trouble? If the cause lies in the failure of lubrication, what form of systematic inspection can be made most effective in remedying faulty lubrication before it has reached the point of failure? We believe that our readers generally will be interested in learning of any measures which have been at all successful in effecting a permanent improvement in hot box conditions. We are, therefore, offering a first prize of $50 and a second prize of $35 for the two best papers describing measures which have been successful in effecting a definite and permanent improvement in the hot box situation, and setting forth as specifically as circumstances will permit just what the results have been. The papers should be received at the office of publication, 30 Church street, New York, on or before March 1, 1924. Papers other than the prize winners that are published will be paid for at space rates.

Improvement in Equipment Conditions

One of the outstanding features of railway progress during the year which has just closed was the remarkable improvement effected in the condition of railway motive power and cars. Had it not been for the splendid condition of the equipment during the summer and fall of 1923, American railways could not possibly have handled the heavy traffic which they did handle so expeditiously and efficiently. Credit for the improvement effected in railway equipment conditions must be given in the largest measure to the mechanical department. We wonder, whether the mechanical department men themselves realize how much they actually did accomplish or how far reaching were the results of their work.

The statistics show that on January 1, 1923, the railways had 13,587, or 21.1 per cent, of their locomotives held for repairs requiring over 24 hours, this large number and percentage still reflecting the effects of the shop employees' strike of 1922. On December 1, 1923, the number of locomotives held for repairs requiring over 24 hours had been reduced to 9,755, or but 14.9 per cent. As a result of this, the number of locomotives in serviceable condition on December 1 was 53,764, an increase in available motive power units over last January 1 of practically 5,000. There were at the beginning of 1923, 216,011 freight cars in bad order, or 9.5 per cent of the total cars on line. On December 1, 1923, there were only 155,626 cars in bad order, or but 6.8 per cent. In effect, this meant an increase in available serviceable cars of approximately 60,000. The improvement effected was due to two factors, one of which was the addition of new equipment replacing old, worn out units, and the other the performance of the railway shops and car repair yards. Every mechanical department man knows what he individually accomplished in connection with the work which was done. He is entitled to know also that the mechanical departments as a whole accomplished a result such as even the most optimistic would not have believed possible but a few months ago.

The railways in 1923 handled a record-breaking traffic without car shortage or congestion. There is enough credit for this performance for all departments to share, but the fact remains that the tools with which the work was done were the serviceable cars and locomotives, made so and kept

so by the mechanical department. Expert students of business conditions give the remarkable operating performance of the railways during 1923 great credit. They emphasize the difference which existed between 1923 and our previous record-breaking traffic period of 1920. In 1920 there was congestion, car shortage and delayed freight movement. In that period consignees could not secure their freight shipments with promptitude. As a result they duplicated their orders and manufacturers and distributors—wholesale or retail—were compelled to build up large stocks of raw materials or goods so that they could make deliveries from stock without having to wait indefinite periods for consignments, from which to fill their orders. Capital and credit were tied up in enormous inventories or in shipments on the road. The inflation, of course, could not continue; late in 1920 the boom burst and in 1921 the reaction was so sharp as to give us a severe depression.

As a result of the splendid railway performance in 1923 the contrast between the conditions existing now and those at the end of 1920 is striking, the business experts say. Business was good in 1923; but there was no inflation. There was no need for excess production nor were excess inventories built up. Prompt railway service necessitated no undue call by business men on the banks for credit. Putting two and two together this means, the experts point out, that efficient railway service in 1923 has given us the basis of a prosperous 1924.

If it is true that the splendid operating performance of the railways in 1923 was largely due to the record made by the mechanical departments in the repair of cars and locomotives, this means plainly that they have done this country a great service. We wonder if, as the mechanical officers and men saw the unserviceable equipment reduce in quantity week by week, they realized how far reaching the effect was going to prove.

Engine Terminals and Locomotive Utilization

There is one subject which warrants the earnest attention of railroad mechanical men in January—and every other month of the New Year. It is the present condition of locomotive terminals and the way in which they limit locomotive utilization and consequently railroad net income. While a few of the more recently constructed terminals are large enough and sufficiently well equipped to handle locomotives promptly and economically, this cannot be truthfully said of the majority of over 3,200 enginehouses on Class I railroads in the United States. Many of these were only just large enough to handle the business at a given point when they were built 20 or more years ago, and were long since outgrown. Others never had the required machinery, equipment, or facilities for minimizing labor costs.

The prime essential for the movement of traffic is adequate motive power and since the number of hours that power can be kept in service is inversely proportional to the time required for conditioning it in engine terminals, the importance of terminals and their direct relation to railroad earnings are plain. From the latest statistics available locomotives are in service only an average of eight hours out of 24, and are turned 1.4 times in 24 hours. The results obtainable by improved terminal facilities and in some cases terminal relocation to reduce the time element per engine turned, and the frequency of turning was strongly emphasized by L. K. Sillcox, general superintendent of motive power of the Chicago, Milwaukee & St. Paul in a paper read before the Western Society of Engineers, March 13, 1923. A striking paragraph quoted from this paper is as follows: "The average cost of turning power is now approximately $6 to $8 per engine turned and the average number of turns is 1.4 per serviceable locomotive day. A revision of facilities that, by reducing the time element of turning, would produce a reduction of 50 cents per engine turned and reduce the frequency of turning 0.1 turning per day (say from 1.4 to 1.3), will accomplish an annual economy on a complement of 2,000 locomotives to the extent of approximately $650,000, an amount which would pay interest at 5 per cent on $13,000,000. Such an appropriation, properly distributed over the system, would provide for a great many time-saving features which, if utilized advantageously, would produce large returns on the investment and at the same time recover many serviceable locomotive hours to revenue service."

In times of peak load, locomotive utilization (service hours), limited by the present lack of terminal facilities, restricts railroad income, and the railroads are at all times subject to excessive terminal labor costs, owing to the deficiency in coal- and ash-handling machinery, enginehouse cranes of various types, machine tools, drop pits, power trucks and many other labor-saving devices. Railroad officers can address themselves to no more important task than a study of present terminal conditions with a view to developing some comprehensive, workable plan for their early improvement.

People Who Live in Glass Houses

"While railroad shops are, as a rule, not as efficient as they should be, there are a few which, in the matter of methods and equipment, stand out as examples to all the rest." This remark by a leading authority in the machine shop industry, brings to our minds the old familiar maxim about "people who live in glass houses should never throw stones." We cannot help but agree that his statement is true, but why limit it to railroad shops? The same thing can very well be said of practically every other industry and such a statement can be substantiated by fair investigation.

The history of industrial engineering shows that its most outstanding successes have been in new plants where it has been able to have its way in the matter of shop layout and in the selection of machine tools. An inspection trip through various manufacturing plants, power stations and other industries revealed that the newer installations had better and more efficient methods than the older plants. This was for the simple reason that new systems and machinery had to be installed and, of course, the latest and best suited were adopted. In some of the older plants inspected, the machine tools and systems in vogue were no better, and in some cases not as good, as the average railroad shop built at about the same time. Everything considered, it was difficult to see any difference between the development of these plants and that of railroad shops built during the same period.

On account of the character of the work usually performed in a railroad shop, industrial engineers, until recently, have been rather wary of tackling the railroad shop problem. Railroad shops have always been placed in the jobbing shop class. Problems of routing material, placing various machine tools on a production basis, the trouble of adapting time studies to repair work and the necessity of complying with government rules and regulations have always appeared as somewhat of a Jonah. However, recent developments in operating conditions, equipment, shop buildings and machine tools, have enabled the railroads to adopt methods of performing work in repair shops that are in many respects unlike, but just as efficient as those used in straight production work.

It is not to be denied that the railroads are forging ahead in the adoption of efficient methods in the maintenance of their equipment. This fact is well brought out by reviewing the various articles describing new shops and improved methods of management installed in others, which have been published in the *Railway Mechanical Engineer* during the past year. Where justified, railroads having shops with old

buildings and equipment have purchased new machine tools and other facilities, and by rearrangement have obtained an output that can compare favorably with that which will be found in manufacturing plants of similar age and size. The newer shops are far in advance of anything that has ever been done. Efficiency in methods of doing work in the railroad shop is rapidly developing into a separate and distinct field, a field which is unlike that of straight production work.

It is just as unreasonable to select a modern railroad repair shop and compare it with the manufacturing shop of 20 or 30 years ago, as it is to compare a modern manufacturing shop with an old railroad shop. Like every other industry under the sun, railroad shops are not as efficient as they should be, and, like every other industry, there are also a few that "stand out as examples to all the rest."

Relation of Equipment Design to Maintenance

An unusually heavy volume of traffic was handled by American railways during the year just closed. That this was done without the usual and anticipated congestion and car shortage was due in a large measure to the exceedingly creditable work done by the mechanical departments in reducing the number of cars and locomotives being held for repairs. The carrying out of this most important work required the expenditure of enormous sums of money and absorbed a considerable percentage of the railroad revenues. How much of this expenditure might have been avoided had the question of maintenance been given more careful consideration when the designs were prepared, or had the engineers and draftsmen known more about what parts were liable to failure and why, is something that no one can say with assurance. That the expenses were considerably increased due to such a lack of knowledge or to a failure to take everything into consideration when preparing the designs of locomotives and cars is undoubtedly true. Feeling that the men in the mechanical department, who are actively engaged in keeping cars and locomotives in good operating condition, would be able to offer some valuable suggestions as to changes in design that should tend to reduce wear or failures and thereby lessen the expenditures necessary for keeping rolling stock in a proper condition, the *Railway Mechanical Engineer* announced in the December issue two prizes for the best contributions outlining what had actually been done or what might be done in this direction. There is a very real connection between design and cost of maintenance. Progress always is gained first by recognizing where improvements may be made and then by making them. As this competition closes on February 1, there is not a great deal of time left, but enough for those of you who have practical suggestions to send them in if you do not postpone jotting down your ideas on this ever important subject. Let us have your contribution for the betterment of the service.

Home-made Oil-Burning Equipment Wasteful

In view of the amount of fuel oil used in railroad shops, engine terminals, car repair yards, etc., it is plainly of the utmost importance that it be burned efficiently and this implies the utilization of furnaces, torches, forges and burners of scientifically correct design. The *Railway Mechanical Engineer* has called attention in the past to the wastefulness of the large majority, if not all, home-made equipment of the type referred to because it is made by shop mechanics who have neither the specialized experience nor the facilities which outside manufacturers can bring to bear on the design and construction of oil-burning equipment. All the different manufacturers' equipments do not cost the same nor operate with the same degree of economy, however, and the only fair way is to subject them to comparative tests and buy the one which shows the most economy in conjunction with satisfactory work. (*Within reasonable limits, price should have no bearing on the type of oil-burning equipment selected.*)

In line with these views one progressive railroad has recently tested some home-made oil-burning rivet forges as compared to the best manufacturer's forge which could be obtained and the results showed so plainly the superiority of the latter that this railroad has discontinued the practice of making its own forges and oil-burning equipment. During one of the extended tests the consumption of fuel oil by the manufacturer's forge was only 234 gal. as compared to 520 gal. by the home-made forge and this saving in oil also meant a saving in air which costs money to compress. Moreover, there was a serious question as to the quality of the product turned out by the forge which burned such an excessive amount of fuel.

The facts developed in the tests referred to prove beyond question that in the long run the best oil-burning equipment obtainable is cheapest to operate, and it is doubtful if home-made equipment of this type can ever compete successfully in a fairly conducted comparative test with that made by manufacturers.

Efficient Shop Management

One cannot but be impressed when reading the article in this issue by Frank J. Borer, freight shop foreman of the Central Railroad of New Jersey, which was awarded the first prize in the shop management competition, with the fact that it is a mighty human document. True, he does go into the mechanical details of management, but always from a point of view, which is not far in the background, of developing enthusiasm and a spirit of co-operation among the employees (the word "employee" in this connection being used in its larger sense of comprehending both officers and workers, because they are all employees).

One of the most outstanding developments in the railroad field during the year 1923 has been the growing consciousness on the part of all of the factors involved in railroad management and operation, of the importance of the personnel question. This is reflected, for instance, in the letters which chief executives sent to the Railway Age for publication in its Annual Review Number, extracts of which follow:

C. E. Schaff, president of the Missouri-Kansas-Texas Lines, for instance, said: "I believe the education of employees by means of circulars, magazines, lectures, conferences with their officers on safety and other operating matters, has accomplished much and if continued will further promote harmonious relations between employer and employee."

Ralph Budd, president of the Great Northern, said: "Promoting better understanding by railroad employees is a somewhat different problem, but even more important (than public relations). It can only be accomplished by efforts on the part of individual roads to get and keep the confidence of their employees by explaining points commonly misunderstood and misrepresented, by fair dealing with the employees, and by making an honest effort in each case of complaint to settle the controversy as promptly as possible."

C. H. Markham, president of the Illinois Central, said: "One of the noteworthy items in the achievements of the railroads during the last year has been the betterment of their relations with the public and their employees. Railway executives are coming more and more to look upon these problems as being fully as important as any other phase of railway management. The morale of the railway personnel

is founded upon a knowledge and understanding of the railway situation. Forces are constantly at work to spread false information and create misunderstanding. If allowed to go unchecked, these forces would seriously threaten to undermine the efficiency of the railway service. To meet this situation, to give the officers and employees of the railroads a working knowledge of the facts about their business and to interpret that knowledge to them in a way that will be reflected in loyalty to the railroad and the spirit of railway service, is a task which challenges the managements of American railroads today. It has been well said that the railroads are not only twenty-one billion dollars of invested capital, are not alone the locomotives and cars and roadway and structures and other facilities of the railway plant, but are two million men and women engaged in the operation of this plant provided with these funds. To the end that their work shall be performed efficiently and economically, in a spirit of true service and a striving for the better things of life, there needs to be leadership from the managements, as well as courage and high purpose within the ranks."

J. E. Gorman, president of the Chicago, Rock Island & Pacific, said: "A constant and unremitting attention to all of those things calculated to encourage confidence toward the management on the part of employees, and a spirit of co-operation and teamwork, establishes a basis for public appreciation and support. Adherence to a policy of fair dealing with all employees is necessary. An effort to bring to the attention of employees the facts which are so much in public controversy, and the mutual interest of the employee and the management, will unquestionably be helpful in this direction."

We always associate mechanical engineering with the mechanical department of our railroads, but the question is whether we have sufficiently considered the application of mechanical engineering to this department in its largest sense. For instance, the following is a very generally accepted definition for engineering: "Engineering is the science of controlling the forces and of utilizing the materials of nature for the benefit of men, and *the art of organizing and of directing human activities in connection therewith.*" [The italics are ours.]

Engineers are beginning to recognize the thing that is so aptly brought out by Mr. Borer in his closing paragraph, and that is, that after all, it is the spirit which dominates an organization that is the most important factor in securing enthusiasm and co-operation. The trouble is that clean-cut and frequent demonstration of this spirit must be made on the part of the management. We may have a very high regard and love for a person, but unless that spirit is frequently experienced, or demonstrated in practical ways, it will not be recognized or understood. The management, or representatives of the management, must therefore take pains to make dead-sure that their friendly attitude toward the employees is clearly understood and they must constantly seek ways and means of demonstrating this in practical terms.

Not only must the "weeds of misunderstanding" be cleared away, as suggested by Mr. Borer, but the workers must be considered as individuals and steps must be taken to see that they are given the proper incentives. In this connection it may not be out of place to quote an incident which is recorded in the book on "Science and Common Sense in Working with Men," by Walter Dill Scott and M. H. S. Hayes, published by the Ronald Press Company.

"Incidents can be multiplied indefinitely to point the importance of applying the right incentive. We can go through the whole category of instincts, emotions, sentiments, and habits that are discussed in a text book of social psychology and match the greater part of them with incidents where they functioned as incentives. Let us tell you, for example, a story told by Colonel Johnson, who was connected with that combat division in France which included Sergeant York in its ranks.

"A boy from the mountains appeared in a southern camp during the war. He was a 'conscientious objector.' The procedure for handling these offenders was expressible in the phrase, 'Treat 'em rough.' In fact, the commanding officer in this case said, 'Give him hell.' Under that treatment this mountaineer would in a few days have been sent to Leavenworth as incorrigible. 'Treat 'em rough' worked in many cases for the conscientious objector, but it would not work in this case. Then a new officer was put in charge, one who tried new tactics. He appealed to this conscientious objector on the ground of duty and loyalty. He argued that it was his duty to advance the Kingdom of God on earth and to fight against the enemy of truth, and the red-haired York yielded to that treatment and went to the front. In a single day with his own rifle and revolver he shot 60 officers and privates in the German army and brought home 183 prisoners.

"The motive applied was the motive which appealed in that particular case. A shift of motives changed that man from a criminal to an American idol and one of the greatest heroes of the American army. In industry today we have a lot of trouble-makers, agitators, loafers, people who are not interested in the job, but some of them are as they are because of the treatment they are receiving. There are some who could be converted into Sergeant Yorks of industry if they were handled as wisely."

Is It Really Worth While?

How shall we train the shop apprentice in order to develop him for the best future interests of both himself and the railroad? Can we succeed by treating him in an impersonal way as one of a group, or must we consider his peculiar personal characteristics and make him feel, as an individual, that the railroad business is really worth while and that he can become an important factor in it? These are difficult questions to face. The apprentice problem—or training men for the future—in the mechanical department has been considered, where it has been considered at all, as a more or less incidental matter, except for a very few roads.

Sixteen years ago tremendous and prolonged applause followed the presidential address of J. F. Deems before the Atlantic City convention of the American Railway Master Mechanics' Association. In closing he said: "We have inherited; what shall we bequeath? What shall we leave to aid in solving the problems of the future, many of which may be much more perplexing than those we are called upon to solve today? We may work in brass and steel, and leave the most perfect mechanism; we may develop and improve and evolve methods and practices until nothing more can be desired; we may reach perfection in all these, in mechanism, structure and method, and yet our bequest be a failure and itself a burden unless we provide that which is paramount, which is over and above the sum total of all this, and for which even today events throughout the world are crying aloud—*the man.* A man prepared, experienced, earnest; hopeful and happy; consecrated to his work and ready to the hand of the future. * * * Our own future, and the hope of that larger future which lies beyond, depends on our efforts and our success in providing those who are to help us today, and upon whom at no distant day must fall our duties, our opportunities, our honors and our families. Have we any greater, grander, more sublime obligation than this? Can we justify a pride in our life-work if we fail in this?"

Some splendid things have been done in apprentice training since Mr. Deems made this statement—done, however, on a pitifully small number of roads when we consider the great question at issue. It is doubtful if Mr. McGowan,

the winner of the first prize in the apprentice competition, whose article is published in this issue, ever heard of Mr. Deems' address, but his last sentence, coming from a young man just about to complete his apprenticeship, has almost as strong an appeal in it—"I hope that for the sake of future business and future America, our controlling industry, the railroads, will see the need of an extensive apprentice program."

Is is not high time that those in authority faced up to the situation and took some real forward steps in extending modern apprenticeship training? It is not necessary to experiment or to use untried or questionable methods. A few roads have cleared the path and can point to thoroughly tried out, effective methods which cannot fail if introduced and promoted in the proper spirit. Developments during the past few years have shown more clearly than ever before the need for intelligent, well trained employees and high ideals of organization. The training of apprentices can no longer be regarded as an unimportant or incidental question. It is one of the most vital questions confronting the mechanical department of our railroads today. Now that the executives are awakening to the importance of the personnel question on our railroads, mechanical department officers cannot afford to side-step this question simply because its neglect will not stand out in the current balance sheet with a pointing finger of accusation.

Nobody ever accused John Purcell, of the Santa Fe, of being a theorist or a dreamer. He is eminently practical. He was one of the first to face up to this apprenticeship problem in a serious way. With the support of his management and aided by Frank Thomas, he has aggressively promoted modern, up-to-date apprentice methods for years, and he can well afford to point with pride to the results that are so marked and so evident in the mechanical department of the Santa Fe today. In connection with Mr. McGowan's article we commend the re-reading of the splendid address made by Mr. Purcell at the meeting of the Mechanical Division at Chicago last June. It will be found in the July number of the *Railway Mechanical Engineer,* page 497.

Mr. McGowan's paper bristles with constructive suggestions. Every mechanical department officer who is interested in the future of the railroad business should not fail to read it carefully.

Who is this chap McGowan, and why is he qualified to speak on the apprentice question? He knocked around quite a bit before he settled down to work in the mechanical department. For instance, he worked as a sheet metal trade helper, a carpenter helper, a structural concrete workers' helper, and a laborer in a section gang. Then he tried his hand as an apprentice, serving for a while as a leather worker apprentice, an apprentice in the printer's trade and then for two years on deck, starting as an apprentice seaman. Finally he went to the Atlantic Coast Line as a call boy in the transportation department, then to the shops as a laborer on the scrap pile. The next step was as messenger in the erecting shop and then shortly before his twenty-first birthday, he became a regular apprentice at the machinist trade. He was nearing the completion of his apprenticeship when he entered his article in the contest. While serving as a machinist apprentice he started a correspondence school course in mechanical engineering, and after completing his apprentice course in November he entered the drawing room of the Atlantic Coast Line.

Mr. McGowan is, therefore, pretty well qualified to discuss the apprentice question, and he makes some very pointed and constructive suggestions which are mighty well worth reading. He shows, also, a rather keen appreciation of the human side of this question. If you do not have time to read the whole article, don't neglect to study the two paragraphs in the section entitled, "If We Could Only Get the Boy's Point of View."

What Our Readers Think

The Laborer Can Contribute

TO THE EDITOR:

Your editorial on "The Value of Questions," page 795 of the December issue, contains what I consider one of the best suggestions for bringing out what the employees are thinking about and ascertaining just how many really wish to learn more about their jobs, than anything that I have seen for a long time. But, there is a noticeable exception, between brackets, in the words "Except Laborers."

Why should laborers be thus exempted? There was a time when I too may have been agreeable to this exemption, but after having received the attached letter from one of this class of men, it will be readily seen why this exception is taken to leaving out the laborers. This letter took considerable time to decipher; the original is in my possession, written in pencil on a soiled piece of paper, but nevertheless I consider it a classic. The name of the superintendent of motive power, to whom the letter was addressed in entering the suggestion for a prize of $10 which he had offered for the best suggestion for reducing costs of shop operation during the year, has been changed. The letter refers to a supply of very heavy cane brooms that had been substituted for the usual corn broom that had always hitherto been supplied. I am not prepared to confirm the correctness of figures and savings the laborer quotes, but think this letter makes out a strong case in favor of not exempting them from participation in the Chicago, Burlington & Quincy's bulletins.

OBSERVER.

Mr. Blank,

Supt. Motive Power:

I can't expect to win your good prize because I am only a laboring man and not a mechanical one but just the same I want to see the railroads make all they can.

There is to much talk about railroads being managed wrong and I no this one ain't when you offer a $10.00 prize like you have.

My idea is only in a broom and I can sweep as good as any man I no but with a corn broom it works out like this.

I sweep from the vat to big door in Machine Shop behind pit No. 1 in 3 hours, equals $1.17.

To sweep the same distance with the new kind of heavy broom is 5 hours equals $1.95.

Then you lose 78c. a day.

For the rest of the time I help the machinists.

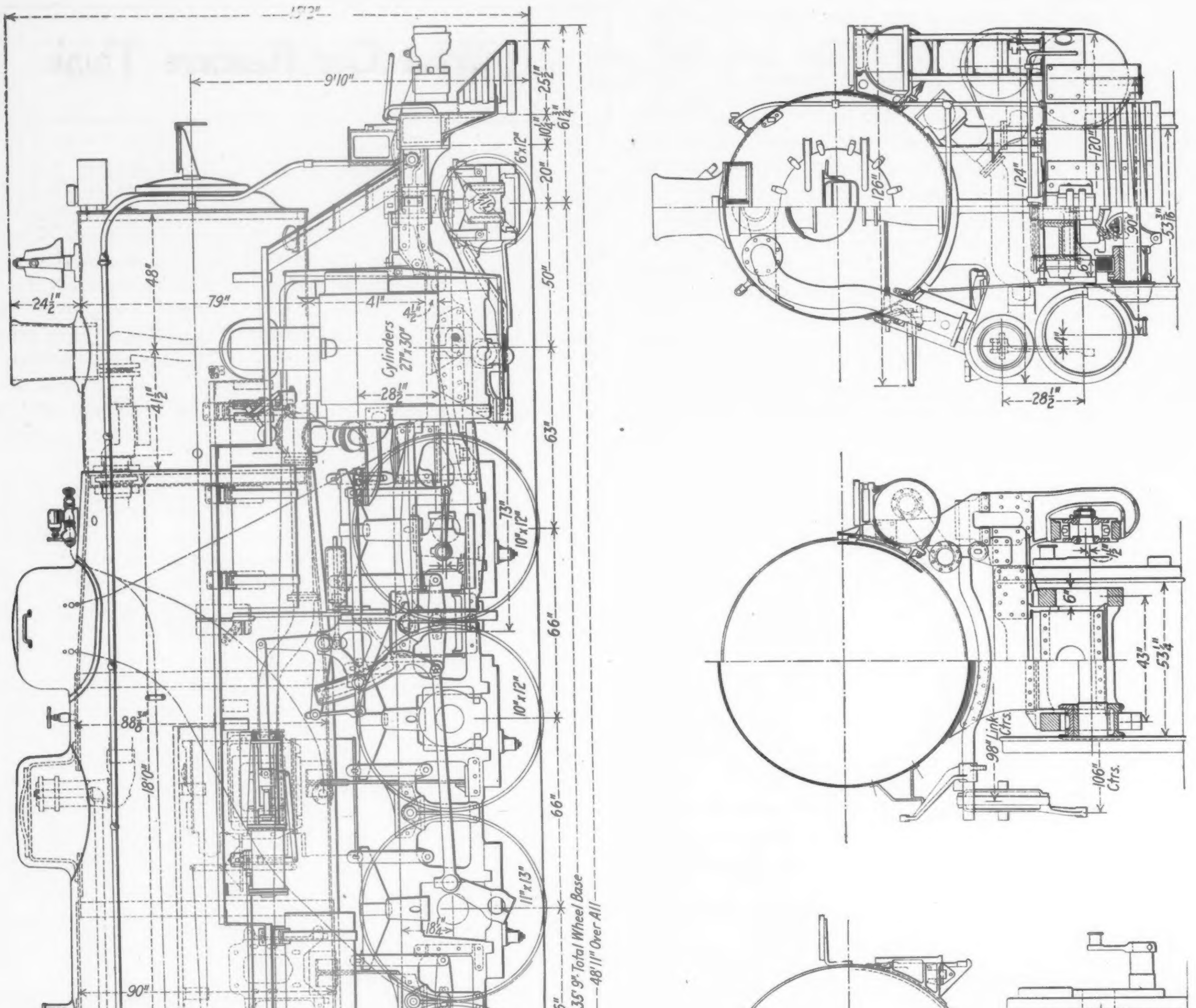
A corn broom lasts about 16 days. This multiplied by 78c. is $12.48 you lose on a hard broom and the hard broom does not last as long.

I have told my boss about these brooms and he says "Do the best you can with them. I do not think they will by any more." Well that is the best I can what I told you about and also your arms about dropp off when you sweep 5 hours with a hard broom and the corn ones do not tire you at all, but I gess they by them hard brooms cheap and they think they make money, but you see how it is, Mr. Blank, don't you? EDWARD G. O'CONNER.

New Books

EMERGENCY BRAKING OF ELECTRIC CARS. *By D. D. Ewing. Bulletin No. 13. Engineering Experiment Station, Purdue University, Lafayette, Ind.* 164 *pages,* 6 *in. by* 9 *in.*

This bulletin contains the report of a series of emergency stop tests made with four types of city and interurban electric cars. The investigation was a co-operative one, participated in by Purdue University, the Central Electric Railway Association and the Westinghouse Traction Brake Company. The manner in which the tests were conducted, the results obtained and the conclusions reached are given in detail.



Cross-Sections and Elevation of Canadian National 2-8-2 Type Locomotive

Canadian National 2-8-2 Type Locomotive with Belpaire Firebox

Canadian National Mikado Type Locomotive

Belpaire Fireboxes and Extended Side Sheets Reduce Troubles from Bad Water in Western Canada

By C. E. Brooks
Chief of Motive Power, Canadian National Railways

WHEN considering the type and design of locomotive to proceed with for handling the increasing traffic of the Western Region, the motive power officers of the Canadian National decided on a Mikado type with a Belpaire boiler as this type of boiler permitted of greater heating surface and steam space. Forty-five of these engines have recently been completed, 35 at the Montreal Locomotive Works and 10 at the Canadian Locomotive Company, Kingston. The locomotives without the booster are classified on the road as S-2-a and are numbered from 3525 to 3559 inclusive. The locomotives with the booster are classified as S-2-b and numbered from 3560 to 3569 inclusive.

A large number of the details used in the construction of these locomotives are also common to the previous order of Mikados and many of the details are common to all Canadian National modern power. The ten engines built at Kingston are identical with those built at Montreal, except for the few changes made necessary on account of the application of the booster to these engines.

The Boiler and Accessories

The boiler is designed with a Belpaire firebox and extended wagon top and conical bottom barrel, the first course being 78 in. and the largest course 90 in. in outside diameter. The firebox proper is 108⅛ in. by 84¼ in. inside and the combustion chamber is 22½ in. long. The boiler horsepower in per cent of cylinder horsepower is 96 per cent.

There are 240, 2-in. tubes and 40, 5⅜-in. flues, 18 ft. 0 in. long; the flues are electrically welded into the back tube sheet according to Canadian National standard practice.

The railway company's standard method of crown staying has been carried out on these boilers and is similar to what was described in a previous article on the Mountain type locomotives.*

The fireboxes are provided with what is known as extruded side sheets. This form of side sheet is being developed on the Canadian National in an effort to overcome troubles due to bad water. With the ordinary flat side sheet, any hammering of the staybolts has a tendency to open up the sheet around the thread of the stay until eventually nothing but the bat head of the stay is holding the sheet. The extruded sheet referred to is so arranged that any hammering of the stays will close the sheet in onto the thread.

These locomotives have been equipped with Duplex stokers and the feedwater supply to the boiler is by means of a Worthington feedwater heater and pump on the left side and that on the right is supplied by a Hancock type E. A. inspirator equipped with 3,500-gal. tubes.

The grates are of Canadian National standard design, the rocking grate bars being of alloy cast steel with detachable lugs. They are operated by Franklin power grate shakers. The ash pans are the Canadian National standard hopper type, the location of the hinges being such that the doors close of their own weight. It was feared that on account of the flatness of the ash pan, owing to the application of the Delta trailing truck frame in connection with the booster, that the grates would be liable to burn out quickly and, in order to overcome this possibility, an auxiliary hopper has been placed on each side of the ash pan, outside of the trailing truck frame. These auxiliary hoppers greatly facilitate the cleaning of the pan and prevent the collection of cinders on the coping.

The ash pans are also equipped with a sludge ejector which consists of a 1¼-in. pipe from the delivery pipe of the inspirator to the ash pans, with a branch extending into each hopper and a valve operated from the cab. The arrangement is specially valuable as it permits the direction of hot water into the pans to thaw them out when the locomotives arrive at a terminal in freezing weather with the pans partly filled.

The superheater, which has 885 sq. ft. of heating surface, is the type A supplied by the Superheater Company and is equipped with forged return bends.

The smoke stack is the railway company's standard three-piece type, the center piece forming the base and fitted to the smokebox, extending down into it. The stack proper and the stack extension fit inside and butt together in the base extension, thus forming protection from the impinging action of

*See *Railway Mechanical Engineer*, August, 1923, page 555.

the exhaust for the center piece, which constitutes the part that must be fitted to the smokebox.

Engine and Running Gear

The cylinders are 27-in. diameter by 30-in. stroke; driving wheels 63-in. diameter with 56-in. cast steel centers; boiler pressure 185 lb. and the rated tractive force 54,600 lb. The cylinders follow Canadian National standard design, being equipped with railway standard by-pass valves and four standard cylinder cocks to each cylinder, two being placed at the ends of cylinder barrel in the usual manner, one placed at the center of barrel and connected with a drain pipe from the bottom of the steam chest (this pipe is covered by the cylinder jacket), the fourth cock being piped to the exhaust cavities which are drained from each quarter. All eight cylinder cocks are operated in unison by one set of levers. The cylinders are also equipped with railway standard relief valves. The crosshead is fitted with the Rogatchoff adjustment which permits the adjustment of the shoes to take up wear.

Steam distribution is provided for by a Walschaert valve motion controlled by a power reverse gear and all parts are interchangeable with previous Mikados. The diameter of the piston valve is 14 in. and the setting is as follows: Travel 6½ in.; lap 1 in.; lead ⅛ in.; exhaust clearance 0 in.

The rear end is fitted with a Commonwealth cast steel cradle casting. The trailing truck is of the Commonwealth constant-resistance type with 43-inch diameter wheels.

Cab and Piping

The cab is of the railway company's standard short vestibule type and has many unique features. This type of cab makes it possible to have almost all the short stays in the sides of the firebox out clear of the cab. The few that remain inside are of the F. B. C. flexible type. The cab is securely riveted to the boiler with a 3-in. by 4-in. angle iron around the whole front of the cab and on the boiler and, in order to take care of expansion the cab brackets are provided with a groove permitting the cab to slide on the cradle casting.

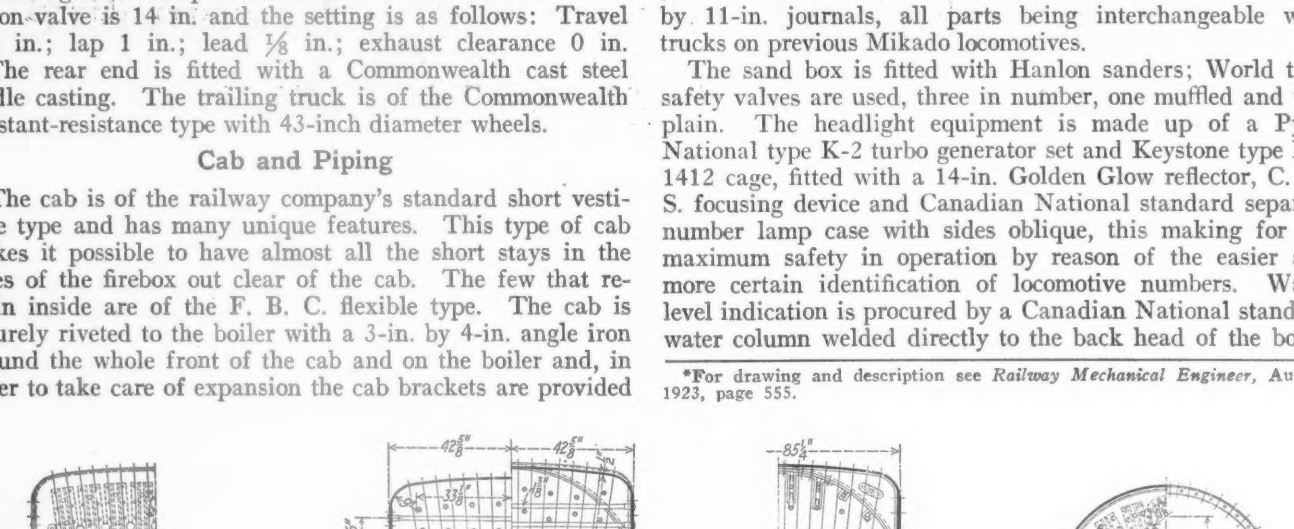
The cast steel turret* with eight outlets has been placed outside far enough ahead of the cab to permit of grinding in or packing the operating valves which are all of one standard size entering the turret horizontally from the rear with the valve seats at the front of the turret. These operating valves are fitted with extension handles carried into the cab and labeled. Not only has the turret been placed outside the cab, but the inspirator, the blower valve and the stoker engine valve as well. Wherever a valve is outside of the cab and under the jacket, a slide has been provided in the jacket directly over the valve so that it is easily accessible.

Other Features

The tank is of the water-bottom type of Canadian National standard design and construction, somewhat modified for the application of the Duplex mechanical stoker. The tank has a water capacity of 8,300 Imperial gallons (10,000 U. S. gallons) and a coal capacity of 12 tons. The tender frame is of the Commonwealth cast steel type. The tender trucks are of the 4-wheel pedestal type equipped with 34¼ in. wheels with semi-steel centers 28 in. in diameter and 6-in. by 11-in. journals, all parts being interchangeable with trucks on previous Mikado locomotives.

The sand box is fitted with Hanlon sanders; World type safety valves are used, three in number, one muffled and two plain. The headlight equipment is made up of a Pyle-National type K-2 turbo generator set and Keystone type No. 1412 cage, fitted with a 14-in. Golden Glow reflector, C. M. S. focusing device and Canadian National standard separate number lamp case with sides oblique, this making for the maximum safety in operation by reason of the easier and more certain identification of locomotive numbers. Water level indication is procured by a Canadian National standard water column welded directly to the back head of the boiler

*For drawing and description see *Railway Mechanical Engineer*, August, 1923, page 555.



The Boiler Is of the Extended Wagon Top and Conical Bottom Type with Belpaire Firebox

and fitted with the railway company's standard try cocks and water glass fittings. The water glass is fitted with a special guard. The steam heat reducing valve is of the World-Leslie type and the piston and valve rod packing is King metallic. Franklin radial buffer and Unit safety bar are used between the engine and tender, and the piping between the engine and tender is equipped with Barco joints. These engines are fitted with Shoemaker firedoors.

The accompanying data table is for the locomotives to which a booster was not applied. The addition of the booster brought the total weight of the engine up to 322,450 lb. and inrceased the total tractive force to 65,000 lb.

TABLE OF DIMENSIONS, WEIGHTS AND PROPORTIONS

Railroad	Canadian National
Type of locomotive	2-8-2
Service	Freight—Western region
Cylinders, diameter and stroke	27 in. by 30 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	6½ in.
Outside lap	1 in.
Exhaust clearance	0 in.
Lead in full gear	⅛ in.
Weights in working order:	
On drivers	227,600 lb.
On front truck	29,500 lb.
On trailing truck	57,700 lb.
Total Engine	314,800 lb.
Tender	185,100 lb.
Wheel bases:	
Driving	16 ft. 6 in.
Rigid	16 ft. 6 in.
Total engine	35 ft. 9 in.
Total engine and tender	68 ft. 10 in.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	36 in.
Trailing truck	43 in.
Journals, diameter and length:	
Driving, main	11 in. by 13 in.
Driving, others	10½ in. by 12 in.
Front truck	6 in. by 12 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	Belpaire, Ext. wagon top
Steam pressure	185 lb.
Fuel, kind and B. t. u.	Bituminous coal
Diameter, first ring, inside	76 7/16 in.
Firebox, length and width	108⅛ in. by 84¼ in.
Height mud ring to crown sheet, back	87 in.
Height mud ring to crown sheet, front	68¾ in.
Arch tubes, number and diameter	4—3 in.
Cumbustion chamber, length	22½ in.
Tubes, number and diameter	240—2 in.
Flues, number and diameter	40—5⅜ in.
Length over tube sheets	18 ft. 0 in.
Grate area	63.26 sq. ft.
Heat surfaces:	
Firebox and comb. chamber	268 sq. ft.
Arch tubes	26 sq. ft.
Tubes	2,249 sq. ft.
Flues	1,008 sq. ft.
Total evaporative	3,551 sq. ft.
Superheating	885 sq. ft.
Comb. evaporative and superheating	4,436 sq. ft.
Tender:	
Style	Water bottom
Water capacity	8,300 Imp. gal.—10,000 U. S. gal.
Fuel capacity	12 tons
General data estimated:	
Rated tractive force, 85 per cent	54,600 lb.
Cylinder horsepower (Cole)	2,427 hp.
Boiler horsepower (Cole) (est.)	2,322 hp.
Speed at 1,000 ft. piston speed	37.5 m. p. h.
Steam required per hour	50,480 lb.
Boiler evaporative capacity per hour	48,300 lb.
Coal required per hour, total	7,890 lb.
Coal rate per sq. ft. grate per hour	123.8 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	72.3
Weight on drivers ÷ tractive force	4.16
Total weight engine ÷ cylinder hp	129.7
Total weight engine ÷ boiler hp	135.5
Total weight engine ÷ comb. heat. surface	71.0
Boiler proportions:	
Boiler hp. ÷ cylinder hp., per cent	95.7
Comb. heat. surface ÷ cylinder hp	1.83
Tractive force ÷ comb. heat. surface	12.31
Tractive force × dia. drivers ÷ comb. heat. surface	775
Cylinder hp. ÷ grate area	38.1
Firebox heat. surface ÷ grate area	4.65
Firebox heat. surface, per cent of evap. heat. surface	8.28
Superheat. surface, per cent of evap. heat. surface	24.92

Are You Numbered Among the Conspirators?*

A Locomotive Fireman Presents the Fuel Wasting Possibilities of Many Practices in a New Light

YOUNG man, if the railroad company has run over your pet cow and won't settle, smashed your automobile when you tried to beat a train to the crossing, or done anything else that makes you feel that blowing up a bridge or burning a string of box cars is the very least that will give you sufficient retaliation, don't do it. It is too crude. Besides, perhaps some of your relatives coming to pay you an unexpected visit may be carried through the damaged bridge. A mail order house may have shipped your order in the very cars you burned. Then, too, you probably will get caught and convicted, with a resultant penalty of two to fourteen years at rock crushing.

Use your gray matter. Do something original. Follow me and I will show you a safer and more efficient method of burning holes in the profits of the railroad, which, I take it, is the ultimate aim of your nefarious ambitions.

Get a job as a locomotive fireman on that railroad. Nobody will get wise to you. They will even help you. Who? Why, most everyone working on that road. Here is a partial list of your partners in crime: Engineers, conductors, brakemen, switchmen, yardmasters, road foremen of engines, trainmasters, car inspectors, air inspectors, fire-up men, roundhouse and shop forces, and last, but not least, the railroad companies themselves. Please bear in mind that you cannot pull off all the following stunts on all railroads, but you can pull most of them on any one you may pick out.

Not knowing of any railroad that is paying extraordinary dividends over any of its competitors, one may infer that they are all burning more fuel than is necessary. I have burned car load after car load of coal which I knew, even before I put it in the firebox, was a waste of my energy as well as a waste of coal, and you can do the same. Even if all the railroad officials in the country should read this and start immediately to block your game, you can get in a lot of deadly work before they can possibly plug all of your opportunities.

Now, let's start. All you need is a good set of teeth, a broad back and to be the first applicant after the extra board gets short. Never mind if you are a misfit, so much the better.

Your first education in handling a scoop will be neglected. Instead of taking you to the cinder pit and fire-up house, have you practice with a scoop on an engine at rest, incidentally teaching you the different depths, sizes and types of the different fireboxes you will use, the way to work injectors and lubricators, etc., they start you out on the road with an older fireman who does not take time to tell you these things. Perhaps he is older by only a few days and is not sure of them himself.

After you have ridden a few miles and still none of these wheels and levers have a familiar look, you feel you must get hold of that scoop or you won't learn a thing on this trip. He lets you put in a fire. He watches you closely to see if he is going to get any assistance out of you. If you try to throw your whole body into the firebox when you throw in a shovelful and all the coal gravitates to the middle

*This is part of one of the papers in the International Railway Fuel Association prize paper contest. It was written by a locomotive fireman whose name has been withheld to protect the writer.

of the firebox and none of it goes to the corners and sides and you just cannot make it go there when he tells you to, your practice for this trip is about over because he takes the scoop before you spoil his fire and make his work harder. The rest of this trip you can learn the road and watch how he does it. You are really taking your second lesson before you have had more than an inkling of the first.

After making three or four round trips, one of which has been tutored by the fireman instructor, you are qualified to begin wasting coal on your own hook. Throw in a bunch of large chunks and then cover them with slack as you would smother a steak with onions. Throw in some more; the engineer will drop her down a few notches and help you burn it out. Not until the water begins to get low in the glass will he advise you to lay off the scoop for a little while. Later on you will find this same engineer helping you burn holes in the company's profits by pet schemes of his own: Carrying water too high, excessive working of the engine, not putting on the injector until after the pop has lifted or even closed again, etc. As you progress in knowledge, you will find other ways that the engineer could, but does not, block your game.

The air inspectors will aid you in their own way. To verify their assistance, wait until your train stops somewhere and then go back and examine that leak. See if the gasket is not hardened—if it has not been worn out for a long time—or if the pipe has not been loose for weeks.

The car inspectors, too, may be relied upon. When taking cars from terminal to gravel pit, stone quarry or coal mine, upon arrival you will find some of them with such large holes in the floor that they cannot be repaired at that point to hold the lading and have to be hauled back in the evening.

The men that fire up locomotives have a bit of aid for you. When you get on your engine, look your fire over. Almost bad enough to require cleaning. Looks like a ton or two and burning green and blue in spots.

Others in the shops are looking out for you, too. The valve setter, for instance. Do you suppose he has a share or two in a coal mine? You will feel confident of it when you get an engine that has lost one or one and one-half exhausts out of four. Don't try to get entirely even on this trip. You will get another chance at her later. She has been this way for months.

Then there are the fellows that fix steam leaks. Your engineer reports the piston rod packing blowing. Next trip you have new piston rod packing rings and swab. Foiled? Not long. In a few days it's leaking again. He did not take time to close the guides and the crosshead is oscillating like the cylinders of a logging engine. It takes them a half a day or so to close these guides, where a couple of hours should be enough. That is why she did not get a lasting repair. When it commences to leak again, you won't mind the pound so much.

Perhaps you have already heard from the gentlemen that are supposed to keep the cylinder and valve packing rings tight.

Your never failing helpers are the air sanders and the men that are supposed to see that they work. Sand, you know, was put on an engine to save coal. Doesn't sound good to you? Do not knock the sanders off or plug them with waste. While working beautifully in dry weather or when emerging from the roundhouse, they are not apt to interfere with your plans when it rains and they are most needed. Sometimes it is a stone jammed into the air nozzle, but more often it is moisture—either condensation at the lower end of the pipe or water carried over from the main reservoir. Other times rain has gotten by the gaskets in the sander proper. The sand pipe may be too short or is not in line with the rail. Ever notice how insecurely they are put on in the first place?

This trip they are working nicely. Not much slipping today. Still you are very apt to run out before you reach a new supply. When you arrive at the coal wharf which is located between terminals, you are told that the supply has run out. On the other hand, there may be plenty of sand but you cannot get any because sparrows have built a nest in the supply pipe and sand will not pass out. The railroad is going to pay another installment on that cow during the remainder of the trip.

The operator or the interlocking towerman is occasionally a good fellow and supports you in your role of villain. After your train has stopped because the signals are set against you, go up and see if he is asleep. He will hear you coming up the steps and proceed to give you an excuse, which later on you find to be without foundation. Then, too, there is the distant signal that he has always set against you. In bad weather after your train has slowed up only to find that everything at the tower is clear and you start to pick up speed again, just credit him with the extra coal. You know from past experience that had it been clear, either he was laying off or there were some railroad officers at his tower, possibly with a trap for you.

Now for some others. Perhaps you would say the railroads themselves. Take the equipment and tools furnished—the small indistinct or black-faced steam gage, for instance. At night, after looking into that nice white fire, you look at the gage to see if your steam pressure is rising or falling. You can not tell, and just to make sure you put in more coal. After a while there is nothing left to do but clean the fire. If there had been two good steam gages the engineer would have been watching his gage closer and you would not have had the nerve to pull this one. A 16-in. gage devoted to 250 lb. steam pressure would speak so loudly to you that you would not have the nerve to let her drop back even if you were thinking of your cow at the time.

Avoid engines equipped with arches and superheaters; also those with two water glasses.

Stick to yard engines and those places where you do not have an individual shovel. The one furnished will probably have a corner gone, cracked at the heel, or a poor handle. This is a dandy chance. Your conscience will charge the waste to the shovel.

In the programming of passenger and freight trains out of terminals, you will find many hours in freight service where you may while away the hours by pumping air, simply because they have the habit of calling you just whenever the train is ready, regardless.

Some morning when you are called to take 10 to 50 empties out to an industrial plant, don't complain because you have a grade to ascend. Bear in mind that these same cars came right down this grade last night, right by the tracks where you are going to put them, but no one had given orders to have them set off. Ten to fifteen extra miles mean quite a bit to your cause in this case, especially if it is the customary thing.

Now, when the road foreman of engines tells you to read up so that you may learn how to save coal—perhaps he will not take steps for years to find out whether you have or not—you will find a great deal of matter relative to nozzles and the back pressure due to them. They will tell you a great deal relative to sizes, describe variable nozzles and automatic nozzles and how much coal is used in making draft.

This is a valuable aid to you and one that will be with you for some time. They have been so busy figuring sizes and effects that it does not seem to have entered their heads that there might be another way of getting around the difficulty. There is another way, and when it is developed the question, "What is the effect of back pressure due to nozzles?" will be left out of your examination papers. But surely, young man, you have wasted enough coal by this time to have given you full and complete satisfaction for the loss of a whole herd of full-blooded, registered, pet cows.

Practical Suggestions As To Apprenticeship

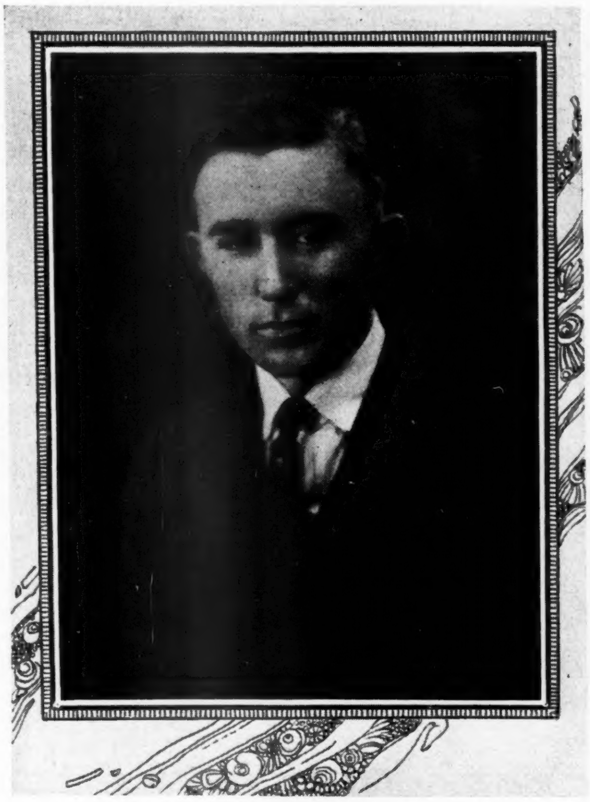
Those in Charge Do Not Recognize the Boy's Point of View and Underestimate His Ability

First Prize*

By. W. L. McGowan
Machinist Apprentice, Atlantic Coast Line, Wilmington, N. C.

OFTEN we have heard an apprentice say, "Tomorrow is my last day, and if the company doesn't keep me I will have a time getting a job elsewhere."

Why? There are many reasons. For instance, he may have been rushed from one job to another, or was kept on one job so long that he could not get all the experience necessary to be an all around mechanic, the result being that he is more of a specialist than a mechanic. Or perhaps he did a lot of detail work, such as threading or putting in bolts and studs, or roughing down work for the real mechanic to finish.



W. L. McGowan

The Neglected Apprentice

Or, by chance, he was put on an assembling job with a narrow-minded mechanic who only allowed him to put in the bolts and cotters. If the apprentice happens not to be quick to understand, in nine cases out of ten if he should happen to ask, "Why do you do it this way, or that?" he will get a sarcastic answer, mingled with profanity, with a "Hand me that wrench," at the end of it. After that he doesn't ask any more, but loafs when sent on an errand. On the other hand, if the mechanic had shown a willingness to give the apprentice the benefit of his experience, the boy would have rushed for the material in order not to miss anything of importance.

I do not believe that 10 per cent of the mechanics are as bad as the fellow mentioned above, but such men can be found in all lines, and the majority are not much better. The average mechanic thinks that the apprentice system is to protect the trade, but fails to see that he could greatly strengthen it by imparting the best of his knowledge, gained by the years of experience. And so when the last day comes and the apprentice boy checks off the last hour, he has no confidence in himself, and if he can't get a job where he is known, he loafs about many days before he gains the nerve to tell an employer he is an all-around man, and takes a chance.

How many college graduates in mechanical engineering find a position waiting for them, as such, when they finish school? "But the apprentice is an altogether different question," someone will say. So he is, but the majority of mechanics turned out by railroads, as well as private concerns, are nearly as far from being mechanics as a graduate in mechanical engineering is from being a mechanical engineer.

You will notice that I speak as though the apprentice depended entirely upon the mechanic for his knowledge of the trade. In the majority of shops he does; that is, in shops where the company takes little interest in the apprentice. In such cases he is regarded as a necessary evil.

If We Could Only Get the Boy's Point of View

I find that the average apprentice is wide-awake to new experiences and a hard worker when an opportunity to do work which requires skill presents itself. Many times, when machining or assembling a difficult job that required skill, I have worked as hard as a man could work, forgetting the clock and my surroundings, not letting up for anything, not even for a drink of water. I even hated to have the noon whistle blow, and when the whistle sounded for 12:30 was right there with my hand on the lever, or with wrench in hand, ready to start. In the afternoon when quitting time came, I would gladly have worked on for half-time or nothing, just to see the job through and gain the experience. On reaching home I would be like a kid with a new toy, would tell my dad and the folks all about my job, and after turning in at night would be as sleepless as a boy on the night before a picnic. Then, after day came and I had checked in for the day's work, maybe the foreman would come to me and say, "Let George finish that and you come over and run the drill press for the day"—then be forgotten for a week or more on the drill press.

That's what knocks the "pep" out of any ambitious apprentice. In lots of shops they don't regard it as an apprentice system, but a method of employing cheap labor. There are many machines that require little or no skill to operate and do accurate work. It is on these machines that the apprentice learns his trade, while the machines that require mechanical skill are operated by the mechanics. The apprentice has a slim chance of getting one. Nearly all lay-out work is done by the mechanic, and there are some that glory in knowing the art. As for the foremen and assistants, they

*This article was awarded the first prize in the competition for regular apprentices, which closed September 1, 1923. Prize awards were announced in the *Railway Mechanical Engineer* for December, 1923.

are more considerate, but in large shops where there are many apprentices, they haven't the time to instruct each and every one of them. Yet I think that they could give the apprentice more experience by instructing the mechanic to see that the apprentice understands the job, and by giving the apprentice the right to complain if he sees he is not getting the proper instructions.

A Data Book Needed

Very few apprentices know the cutting speeds for drills, reamers and other cutting tools. Of the many apprentices coming through the shop when I did, never did I see one refer to a table of any kind. When the job required the use of a tap, the size of tap drill to use was ascertained from some mechanic, or was guessed at. Therefore many valuable taps were broken, sometimes requiring hours to dig them out of the holes, besides making a bad job when finished. Many drills were burned up or broken, material wasted and time lost. Many machines were put out of commission, belts broken, gears stripped, lives endangered, bones broken, and what not, causing the loss of many hours, and the consequent lowering of production, all for the lack of proper instructions.

I sincerely believe that it would pay all companies to get out a printed data book touching on the theory of cutting tools, giving tables of feeds, cutting speeds, etc., and imparting data pertaining to the various departments, with simple formulas, such as are of daily use to the apprentice. Require each apprentice to have a copy, if you have to sell it on the installment plan. I am confident that many hours would be saved, as well as tools and material. Fewer machines would be underworked or overworked.

The Negro and the Mule

Since expenditures for safety on our railroads are alone running into millions of dollars, don't you think a little could be spent in studying the dangers of each machine, and a little booklet handed to each apprentice on the day he starts his service? A little longer and my apprenticeship will be over. I have learned the dangers of some of the machines just as the negro learned a mule will kick. Don't forget that each machine is new to an apprentice.

Recently Judge Gary of the United States Steel Corporation, said, "The hope of American industry lies in its youth." If so, why doesn't one of America's oldest and greatest industries, the railroads, give the youth a chance?

The Hope of the Railroads

H. A. Frommelt, apprentice supervisor of the Falk Corporation, Milwaukee, had an article in the August number of "Trained Men," published by the International Correspondence Schools, dealing with apprentices. It is said that Mr. Frommelt is recognized as one of the leading experts in the field of apprentice training.

The Falk Corporation recognizes the need for men trained from the ranks to hold the executive positions of tomorrow. I believe that it would do the railroads no harm to look into its methods and profit from them. If such methods had been put in effect at the beginning of the century, what a glorious system of transportation we would have today. Some of those who have departed would have reaped a harvest in dividends. Even now, when the roads are hard-pushed to handle the country's ever growing traffic, we have time to start. It was the lack of skilled labor that put them in the hole, and it will be the same that will keep them there if they don't learn to cultivate their own crop. I believe we could start tomorrow without a cent and save enough daily to keep a good apprenticeship system going.

Pertinent Suggestions

First, we must appoint one or more old mechanics, or young, who understand the theory as well as the practice of the trade. Give him full charge of the boys. Give him a chance to study the situation. He's been through the mill—he knows. Have him classify the machines and erecting jobs and outline a schedule. Have a question box. (The apprentices like to ask questions.) The apprentice can write his question and drop it in the box, and in the course of the day the instructor can call on him and talk with him on the subject.

Have the apprentice serve a short term on bolt threaders, bolt skinners, car wheel boring mills, nut facers, cold saws, polishing wheels, etc. Let him serve a definite length of time on drill presses requiring no set-up of work, tire boring mills, tire turning lathes, special work lathes and turret lathes, boring mills, slotters, shapers and all other machines that turn out the same shape and kind of job over and over.

The apprentice should have extensive instruction on general work, heavy-duty or light lathes, boring mills, slotters, shapers, planers, milling machines, quartering machines, key seaters, broachers, grinders, and all other machines requiring skillful as well as accurate workmanship, and requiring the use of precision instruments.

If there are mechanics on these machines, what difference should that make? Give the mechanic an apprentice when he is preparing the work, laying out and measuring preparatory to laying out. Let the apprentice take notes and ask questions. If notes are taken, have them turned in to the instructor in the form of a report. In this way the apprentice will get experience that he otherwise would miss.

Drafting Experience

Before entering the erecting shop the apprentice should understand working drawings. A term in the drawing office would be proper, provided he is not used as a messenger while there. If it is impossible for all, then it should be given to the ones winning in competitions held especially for this purpose.

From the drawing room the apprentice should go to the erecting shop or roundhouse. In the erecting shop the apprentice ordinarily gets stripping, lining shoes and wedges, filing driving boxes, using the acetylene cutting torch, putting in bolts, cotters, flat keys, tightening up nuts, putting up binders, or putting up anything that has already been prepared by the mechanic. Some get squaring up and setting pops and valves. The apprentice should get plenty of lay-out work in the erecting shop and be allowed to make suggestions.

The apprentice has a good show on bench work, such as crosshead, rod, link motion, throttle and reverse lever benches. The air brake and manufacturing tool room the apprentice seldom has time for, while these could easily be brought in with his machine shop practice. If he does happen to get into these departments he is generally used as a handyman.

In the roundhouse the apprentice gets most of the greasy work, but some good experience. In the pipe shop, boiler shop, electric and car shops you will find the apprentice working under nearly the same conditions as at the machinist trade.

I don't remember ever seeing a boilermaker apprentice present at a big lay-out job. The blacksmith apprentice gets about all that's coming to him in the way of practical experience; the sheet metal apprentice also.

I know that the apprentice, regardless of his trade, is wide awake to new experiences, and his one great ambition is to be a good all-around mechanic, and know how to handle the job by blue print. But this he seldom or never learns while serving his time. For this reason he should be made to check details by the drawing.

I hope that for the sake of future business and future America, our controlling industry, the railroads, will see the need of an extensive apprentice program.

The Manufacture of Railroad Engine Greases

A Discussion of the Materials and Processes Entering Into the Production of These Lubricants

By H. L. Kauffman

DRIVING journal compound and rod cup grease constitute that class of greases known as railroad engine greases. They are both hard greases of the soda soap type. Consequently, their general characteristics and methods of manufacture are the same. These greases are made by the cold saponification of fats with caustic soda in the presence of the proper amount of mineral oil.

No other grease that is made must meet the strenuous service requirements that are demanded of driving journal compound. The lubrication of the driving axle journal is more important than the lubrication of any other part of the locomotive. The driving axle boxes of locomotives support the weight of the boiler and its fittings. The pressures per square inch will vary from 200 lb. to 600 lb., depending upon the size and type of locomotive. Owing to the conditions existing in locomotive practices and design, such as the gage of the track, width of the fire box, and so forth, the driving axle journals are made as short as possible. As a result, their length is approximately the same as their diameter. This condition is not found in stationary practice, because the length of the journals is not limited, and as a result it is general practice to make the bearings twice the diameter of the journal in length. It is therefore evident that with the enormous weight on the driving axle journals, and the high rubbing speeds of the journals of fast locomotives, combined with the reduced bearing area and the resultant increased bearing pressure per square inch, that the lubricating conditions are unusually severe.

On smaller engines not fitted with cellars for using journal grease a suitable cylinder stock is used. On the journals of most locomotives, however, there is a cellar below the driving axle to feed the grease to the journal. The grease is molded to the shape of the cellar and placed on the follower plate. A spring is arranged to push the follower plate upward, thus squeezing the grease through the perforated plate, shaped to the contour of the journal and kept from it at a distance of about 1/8 in. Oil grooves are cut to distribute the grease. There is one hole through which some grease reaches the hub face of the wheel, while another hole is arranged for lubricating the shoes and wedges.

The grease must be exceedingly hard to give good results in service. This is necessary because of the great pressures on the journals and the strong spring pressure in the cellars. With a single packing an engine should make a large number of trips, as the springs are so arranged to feed most of the grease from the cellar with only occasional attention. An advantage of grease lubrication of driving axles lies in the fact that grease resists being squeezed out from between the bearing surfaces, but nevertheless can be forced into the bearings at high speeds. It offers greater frictional resistance at high speeds than oil does, but, in spite of this fact, at low speeds and for starting, the thicker film present reduces the frictional resistance, due to the greater separation of the bearing surfaces. Consequently, there is a reduced tendency for the bearing surfaces to interlock.

Rod cup grease is very similar to driving journal compound, although it usually contains a lower percentage of soda soap. To lubricate the pins on driving wheels, the grease is forced into a 2-in. cylindrical grease cup in the driving shaft, and a screw which just fits this opening is screwed in until it presses on the grease sufficiently hard to force grease in the bearing below. As the bearing warms up soon after starting, the grease begins to soften a little and lubricate the driving pins. As the grease is gradually consumed the screw is given another turn to force the grease down to the pins. At starting, a pressure of 3,000 lb. per sq. in. may be reached, and a hard grease is therefore required. The pressure is intermittent, first on one side of the pin, then on the other, so that the grease has an opportunity to get in between the rubbing surfaces.

What Is Engine Grease?

A description of the methods of manufacture of railroad greases must necessarily include a few statements concerning the basic theories upon which the process depends.

Let us remember that a true grease is one that contains a soap. Railroad engine grease is, in reality, a cylinder stock thickened with soda soap. Soap is made by saponifying a fatty oil with a base such as soda, potash, or lime. Fatty oils are made up almost entirely of heavy fatty acids in combination with glycerine. In general, glycerine holds in combination three molecules of stearic or other fatty acids. Olein, stearin, palmatin and similar compounds make up practically all of the animal and vegetable oils and fats. A fatty oil is a glycerine of the fatty acid. Soap is the compound formed between soda, potash, or other bases and the fatty acids. This breaking up of the oil into glycerine and soap is called saponification. The process of manufacturing railroad engine greases depends upon the fact that a soap is made by saponifying a fatty oil.

Practical experience has shown that railroad greases are just as good as the raw materials with which they are made. If we make the grease by saponifying a poor grade of cake tallow having a high fatty acid content we are not going to be able to control the temperature of the batch as well, nor will the resultant product be as good as could be made by using a hard tallow containing one-tenth the amount of fatty acids.

Likewise, it is important that the caustic soda used is of the highest purity, and contains no great amount of sodium carbonate. Both the fat and the caustic used in the manufacture of this grease should be bought on specifications, and should be examined by the laboratory to see if those specifications are met before the products are used in grease-making. One large manufacturer of railroad greases rejected a shipment of caustic soda when the laboratory found that it contained an appreciable amount of sand and powdered brick. If this caustic had been used in grease-making, the impurities in it, undoubtedly, would have caused serious complaints on the quality of the grease.

The cylinder stocks that are used vary greatly in their characteristics, depending upon the nature of the crude from which they are made. Experience has shown that if two railroad greases are made in exactly the same manner, the one containing a specially treated cylinder stock low in tarry matter, the other an untreated stock relatively high in tar, the grease made with the cylinder stock low in tar content is the one to give the better service in use.

The table shows the tests of the cylinder stocks used in the manufacture of railroad greases that are marketed at the present time.

Approximately 40 per cent of the samples examined contained a Pennsylvania cylinder stock, about 15 per cent were untreated stocks, while the majority of the others were

cylinder stocks from Mid-Continent crude. The average viscosity at 210 deg. F., of the samples examined was 147 seconds.

Methods of Manufacture

The usual method of manufacturing either driving journal compound or rod cup grease, although not the best since there is no provision for a temperature control of the batch, is, approximately, as follows:

A 50-50 solution of caustic soda in water is made by adding to a container equal weights of caustic soda and water. Steam is emitted into the solution for about 10 minutes through a perforated pipe at the bottom of the container, in order to obtain a complete solution. The caustic solution is entirely too hot at this time to be used in making the grease, and for this reason it must be made 24 to 30 hours before the batch is to be started. A float covers the surface of the caustic solution so that there is less chance for the formation of the carbonate of soda by exposure to the air.

The required amount of mineral oil is measured into the kettle, followed by the measured quantity of tallow, or tallow oil, the former being the more generally used. If driving journal compound is being made, graphite is added to the kettle at this point. After the addition of the required amount of tallow, the contents of the kettle are stirred for about 10 minutes before adding the caustic solution in order to thoroughly mix the oil, graphite, and tallow. The caustic solution, cooled to room temperature, is passed through a strainer attached to the outlet end of the pipe into the kettle over approximately a 10-minute period of time. The acids in the tallow react immediately and form enough soap to emulsify the oils. The contents of the kettle are stirred until the grease commences to thicken, varying from 20 minutes to 90 minutes, and are then drawn off into barrels. The drawing temperature by the above procedure may vary from 120 deg. F., to 135 deg. F.

A grease made by the process of manufacture described above, where there is no temperature control, and consequently no possibility of manufacturing consistently uniform batches of grease, will not give as good service as one made in a kettle where it is possible to control the temperature, and where the entire manufacturing process is well regulated. This statement has been proved by actual service tests made by the railroads.

The driving journal compound giving the greatest number of miles of service per pound of grease used in this country at the present time is made according to the following formula:

	Per cent
Hard tallow	39.6
Caustic soda	8.3
Water	8.3
Cylinder stock (including dye)	43.8
	100.0

This grease is made with a very high grade of hard tallow, averaging about 0.8 per cent free fatty acids, and having a low titre test. The mineral oil used is a treated cylinder stock, cut back with heavy red paraffine oil to a viscosity at 210 deg. F., of 140 seconds. The caustic soda used is of the highest purity, and is the best obtainable grade on the market.

The general procedure followed in its manufacture is as follows: In one small kettle, slightly elevated above the main kettle, is placed the required amount of caustic soda and water. The caustic solution is stirred while cooling, and is further cooled by water passing through the jacket of the kettle. Into another slightly elevated kettle is placed the tallow which is melted, and passed through a screen into the main kettle to which the required quantity of cylinder oil has already been added.

Cooling water is passed through the jacket of the main grease kettle. The cylinder oil and tallow are stirred in the kettle at a temperature ranging from 80 deg. F. to 90 deg. F. One manufacturer keeps the temperature of the room in which the grease is made at 80 deg. F., throughout the entire year. The caustic soda solution, also at a temperature of 80 deg. F., to 90 deg. F., is added to the kettle over a 15 minute period, continuing the stirring. The batch is stirred at the rate of 38 to 45 r.p.m. for three hours at as low a temperature as it is possible to maintain by means of the cooling water in the jacket of the kettle. The drawing temperature will vary from 85 deg. F., to 100 deg. F., depending upon the initial temperature of the caustic soda solution and the mixture of cylinder oil and tallow.

The grease is fluid when drawn, but "sets up" hard on standing. The temperature continues to rise after being drawn into barrels due to the reaction between the caustic soda and fat. This reaction is not complete for several days. It proceeds rapidly at first but the caustic combines with the fat less quickly after 95 per cent to 97 per cent has reacted, due to the low temperature of the grease at this stage and the low percentage of free caustic soda. Even in the presence of 2.75 per cent of free caustic, from 2 per cent to 4 per cent of fat remains unsaponified even on standing for months.

By this latter method of manufacture the maximum temperature rise in the barrels does not exceed 175 deg. F.; by the first described method the temperature may reach 208 deg. F. Although greases made by both methods might appear to be the same, and might even analyze the same, it has been proved beyond any doubt by actual service tests on the railroads that, by providing for a temperature control of the manufacturing process, the physical characteristics of the grease are improved to such an extent that the maximum efficiency in road service is obtained.

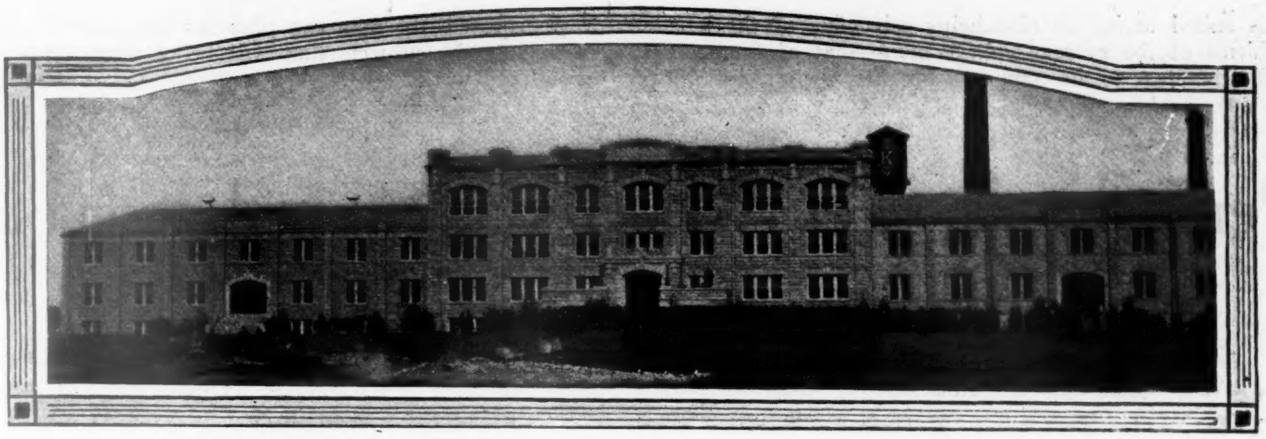
Rod cup grease is made in a manner similar to driving journal compound. The percentage composition, however, is different, and it contains no graphite. Rod cup grease is yellow to yellowish brown in color; driving journal compound of an olive green color due to the graphite or dye which it contains. All railroad engine greases should be "aged" for from 10 days to two weeks before using.

The railroad greases that are marketed in this country at the present time vary in soda soap content from 34 per cent to 54 per cent and in mineral oil content from 22 per cent to 50 per cent. The amount of water present is, in some greases, as high as 19 per cent, while in others it is as low as 7 per cent. A few greases contain no free caustic soda whatsoever, in which case there is present as high as 8 per cent of free fatty oil. Others contain as much as 5 per cent of free caustic, the average being about 2.5 per cent.

In the majority of cases a chemical analysis tells little as to the lubricating value of the grease. A road service test is the only practical method of distinguishing between a good grease and one that has been poorly made.

TESTS OF THE CYLINDER STOCKS USED IN ENGINE GREASES

Sample Number	Gravity	Flash	Fire	Pour	Viscosity at 210 deg. F.	Carbon Residue
Driving Journal Compound						
1	27.0	515	600	75	144	2.10
2	27.3	520	595	75	133	1.89
3	27.2	...	...	75	104	1.63
4	20.8	...	...	65	146	....
5	25.5	505	585	35	146	4.56
6	26.8	530	600	65	138	1.79
7	27.2	460	540	85	120	1.68
8	26.8	460	540	80	130	1.72
9	22.2	540	600	60	151	2.78
10	20.3	475	535	75	118	....
11	21.4	545	625	65	200	3.76
12	27.0	480	560	60	124	2.49
13	22.0	555	625	50	205	....
14	22.1	420	495	60	136	4.89
15	26.8	520	600	80	114	1.73
16	26.4	510	590	75	133	1.60
17	20.4	535	615	65	177	3.32
18	21.8	530	610	75	196	3.40
19	22.1	475	545	70	143	2.58
20	19.7	460	525	55	196	3.41
Rod Cup Grease						
1	25.6	520	595	55	133	3.31
2	21.6	475	530	65	125	....
3	20.2	455	520	55	164	4.90



Engineering Building, Kansas State Agricultural College

Suggestions as to Special Apprenticeship

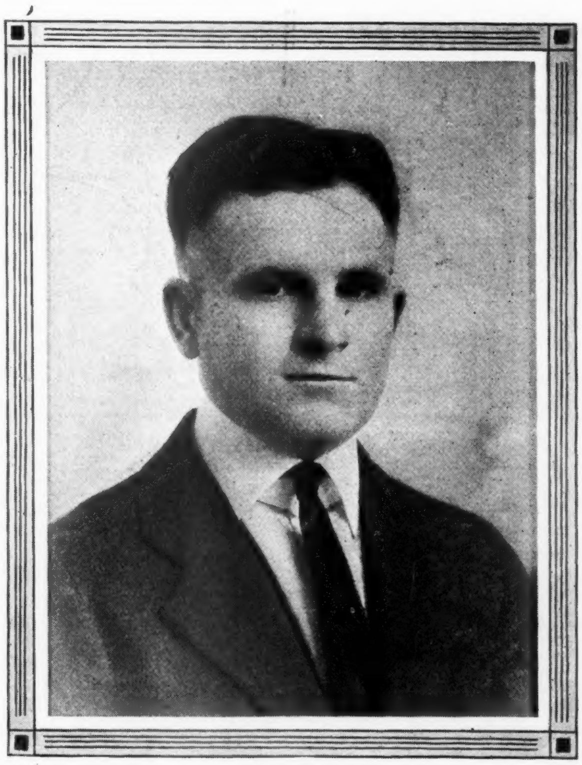
The "Special" Should Set a Good Example and Have High Ideals and Aims

Second Prize in Special Apprentice Competition

By Roy Eckart*

Special Apprentice, Atchison, Topeka & Santa Fe, Raton, New Mexico

THE idea of special apprenticeship still needs to be "sold" to both the railroad managements and college graduates. Most college men have the false impression that there is very litle opportunity for advancement, or for the working out of original ideas, in the railroad shop. Happily, some of the far-sighted railroads have commenced to bid against Westinghouse, General Electric, and other large companies, for the services of the technical graduates of our colleges and universities. These graduates advertise the opportunities that they have found to the undergraduates of their Alma Mater, thus securing their interest and giving them an opportunity to prepare themselves for a similar line of work.



Roy Eckart

What is Expected of the College Man

What is expected of the special apprentice? Undoubtedly, the first thing is that which is expected of every man in the service—work. The technical graduate has the challenge to overcome the prejudice that college men are afraid of work, and that they don't like to get their hands dirty.

You are a little older than the regular apprentices, and have had many opportunities that have been denied them. They will, therefore, look to you as an example. Be careful of the example you set. Not only be accurate and thorough in your work, but also keep your character above reproach, for although you may not realize it, you will, because of your training and ability, be the model for some of the younger apprentices and may even be responsible for the shaping of the lives of some of them. Don't be afraid to give the "new kid" a little encouragement and help if he needs it.

Be a dreamer. Let your dream be that by making some improvement in railroading, you are going to do your service to your fellow man. No college graduate should enter the service unless he believes that he can develop an improved method of doing some piece of work, or perfect some piece of apparatus.

Summer Vacations as a Tryout

Since most men taking an engineering course have no definite line of work they expect to follow after graduation, a splendid opportunity is offered to the railroad companies if they will pick a number of third-year men and let them serve in the shops during the summer previous to their graduation.

This is an advantage to both the man and the company—to the man, for he finds out whether or not he likes the work

*Mr. Eckart is a graduate of the Kansas State Agricultural College, Class of 1922. The Special Apprentice Competition closed September 1, 1923.

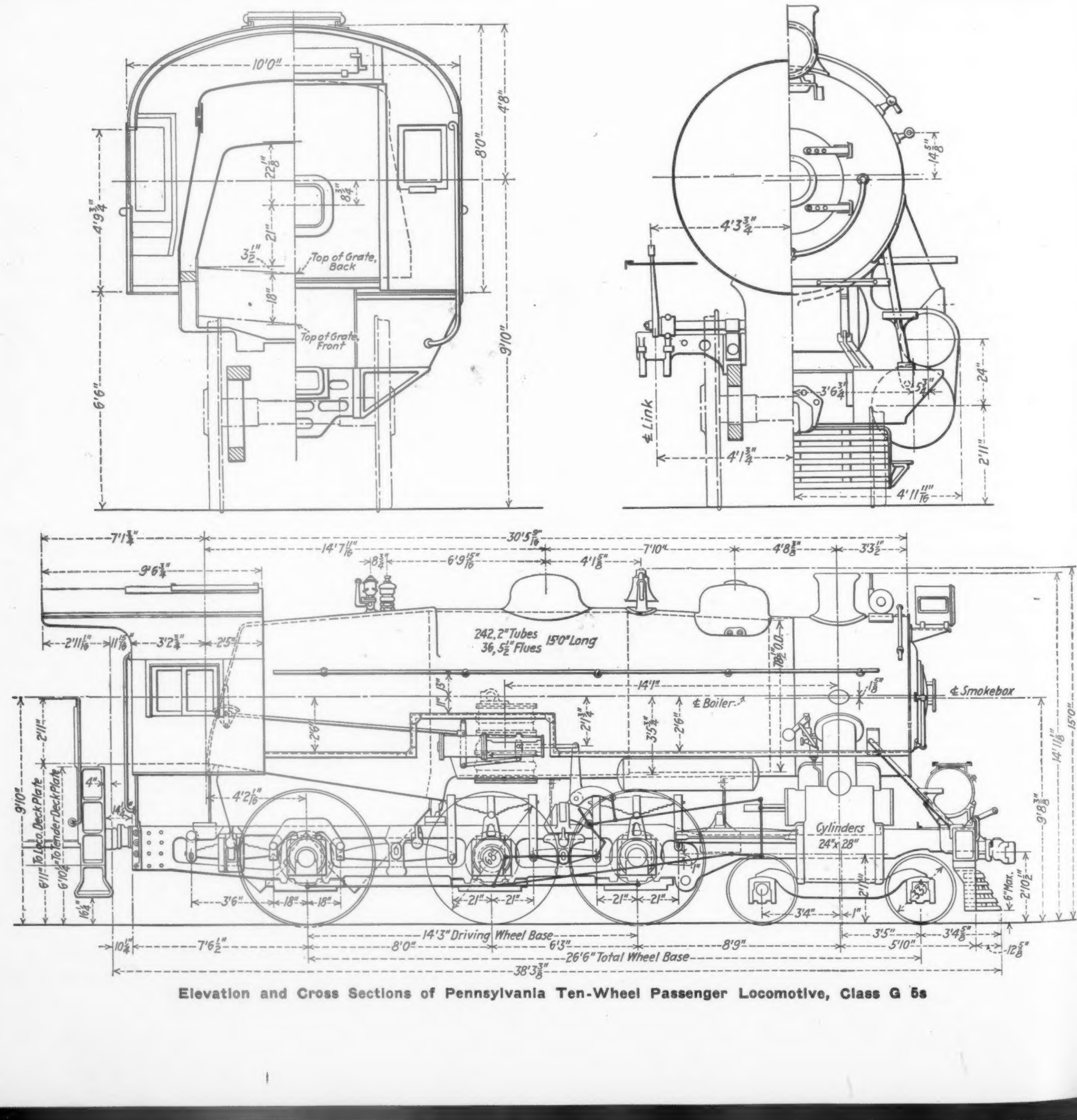
or is suited to it. It also helps solve one of the hardest problems of the average college man—that of finance. It is an advantage to the company, for after seeing the kind of work required, the man can plan his last year of school so as to take the subjects that will be of most value to him in railroad work.

Pennsylvania Ten-Wheel Passenger Locomotive

Class G5s, a New Design for Local Passenger Service with 68-in. Drivers, Develops 41,328-lb. Tractive Force

GRADES often require double heading when using some of the smaller Atlantic and eight-wheel type locomotives in local passenger traffic on the Pennsylvania Railroad System; during the last few years the need for a medium-size locomotive for this service has become urgent. This service requires large tractive effort for quick starting and rapid acceleration to avoid delay in getting trains under way. Tractive effort for this kind of service is of greater importance than high speed.

A ten-wheel locomotive has been designed, of which 40 have been built at the Juniata (Altoona, Pa.) shops of the railroad to meet this requirement. Some of these locomotives are now hauling heavy trains over steep grades on most exacting schedules and the service results amply justify the design. The locomotive has 24-in. by 28-in. cylinders and, with 205 lb. boiler pressure, develops a tractive effort of 41,-328 lb. on 68-in. driving wheels. Although not intended primarily for high speed service, the counterbalancing is such that it may safely maintain a speed of 70 miles an hour. This is made possible by the lightness of the reciprocating



Elevation and Cross Sections of Pennsylvania Ten-Wheel Passenger Locomotive, Class G 5s

parts, which weigh 1,008 lb. on one side, or only .425 per cent of the weight of the locomotive. A piston pressure of 92 lb. per pound of reciprocating parts is thus developed.

Boiler

While the locomotive approaches the Pennsylvania K4s Pacific passenger locomotives in starting force, the boiler capacity compares closely with that of the E6s Atlantic type. Although the shell is somewhat shorter, the tubes have been made the same length by building the firebox without a combustion chamber. In certain details, furthermore, interchangeability has been maintained, both for the sake of maintenance and to simplify fabrication. The E6s front end is an example of the former and the use of E6s dies in flanging the heavy barrel sheet connection for the top of the Belpaire firebox is an example of the latter. The outside throat sheet and the lower half of the rear barrel course are flanged in one piece, but owing to the location of the firebox over the rear drivers, the throat is shallower than the E6s boiler.

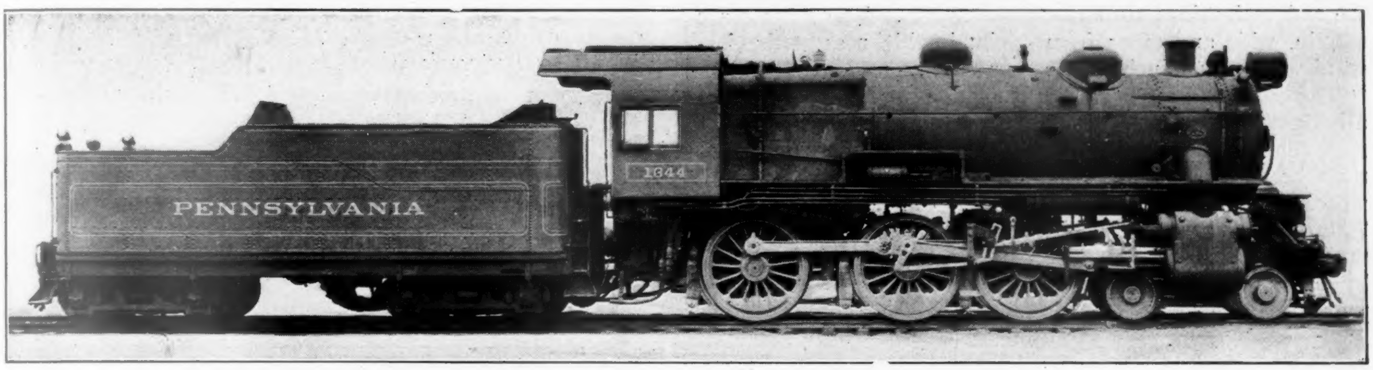
The internal diameter of the boiler is 76¾ in. at the forward end and 81¾ in. at the dome. This has made possible the insertion of 242 two-in. tubes and 36 five-and-one-half-in. superheater flues, the same as in the E6s boilers. The firebox is 110¼ in. long by 72 in. wide and has a grate area of 55.13 sq. ft. It is equipped with a Security brick arch supported on three 3-in. water tubes. The grate is arranged with a slope of 17.8 per cent towards the front.

A Type A superheater, consisting of 36 units, with a heating surface of 798 sq. ft. is used. The front end is of the self-cleaning type with an inside extension to the smoke stack reaching slightly below the center line of the boiler insuring proper draft through all flues.

Steam Distribution

The valve gear is of the Walschaert type with all parts made as light as possible consistent with the strength desired. A standard 12-in. piston valve is used. An air operated power reverse gear has been made standard for this type of locomotive. These designs are equipped with the Alco gear, which is provided with an auxiliary air reservoir and check valve to retain sufficient air for reversing the gear several times, or holding it in place in case the main supply of air fails for any reason.

The throttle is of the floating stem type with drifting attachment, a design which is exceptionally easy to operate and responds instantly to any movement of the throttle lever.

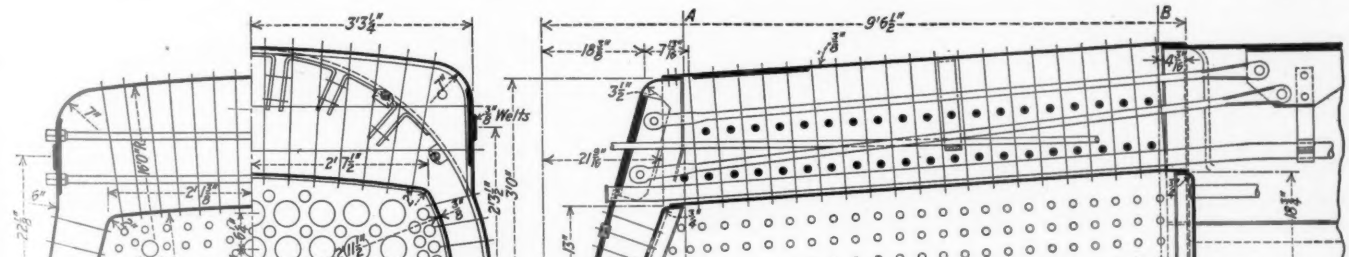


New Ten-Wheel Locomotive for Heavy Local Passenger Service

Frames and Running Gear

The frames are of cast steel four inches wide and reinforced to 7⅞ in. over the driving boxes. The driving axles have a 3-in. hole drilled through the center to facilitate their heat treatment. The journals are 9¾ in. by 13 in.

The piston rods on these engines are not of the extended type but are hollow drilled. They are 4 in. in diameter and



Belpaire Firebox of Pennsylvania Ten-Wheel Passenger Locomotive

have a 2¼-in. hole drilled through the center from end to end. This hole is reduced to 1½ in. at the piston fit and to ¾ in. at the crosshead fit where the ends of the rods are forged down. An important feature in the design of the piston rod is that its length is such as will enable the piston to be pulled out of the front end of the cylinder without cutting the piston rod loose from the crosshead. The piston is made with a rolled steel center and a cast iron bull ring fitted with cast iron piston packing rings.

The main rods are of I-section, 7½ in. deep at the rear end and 7 in. at the front end, with a 5½-in. milled section of the rod maintained throughout the length. The flanges are 4¼ in. wide and taper from ¾ in. in thickness at the forward end to one inch at the rear end.

The crosshead runs on three bar guides and is of exceptionally light construction.

A comparatively large tender is used with these locomotives because of the fact that many of them will be used where track tanks are not available. The water capacity is 7,800 gal. and coal capacity approximately 15 tons. The tanks are carried on four-wheel trucks, the front with 5½-in. by 10-in. journals and the rear will have 6-in. by 11-in. journals.

TABLE OF THE DIMENSIONS, WEIGHTS AND PROPORTIONS

Type of locomotive	4-6-0
Service	Passenger
Cylinders, diameter and stroke	24 in. by 28. in.
Valve gear, type	Walschaert
Valves, piston type, size	12 in.
Maximum Travel	7 in.
Outside lap	1 5/16 in.
Weights in working order:	
On drivers	178,000 lb.
On front truck	59,000 lb.
Total engine	237,000 lb.
Tender	176,500 lb.
Wheel bases:	
Driving	14 ft. 3 in.
Total engine	26 ft. 6 in.
Total engine and tender	62 ft. 7¼ in.
Driving wheels, diameter outside tires	68 in.
Boiler:	
Type	Belpaire, wide firebox
Steam pressure	205 lb.
Fuel	Bit. coal
Diameter, first ring inside	76¾ in.
Firebox, length and width	110½ in. by 72 in.
Height to crown sheet, back	48 in.
Height to crown sheet, front	73½ in.
Tubes, number and diameter	242—2 in.
Flues, number and diameter	36—5½ in.
Length between tube sheets	15 ft.
Gas area through tubes and flues	6.92 sq. ft.
Grate area	55.13 sq. ft.
Heating surfaces:	
Firebox, comb. chamber and arch tubes	185 sq. ft.
Tubes and flues	2,677 sq. ft.
Total evaporative	2,862 sq. ft.
Superheating	798 sq. ft.
Comb, evaporative and superheating	3,660 sq. ft.
Tender:	
Water capacity	7,800 gal.
Fuel capacity	29,300 lb.
General data estimated:	
Rated tractive force, 85 per cent	41,328 lb.
Cylinder horsepower (Cole)	2,128 hp.
Speed at 1,000 ft. piston speed	43.3 m. p. h.
Steam requires per hour	44,262 lb.
Coal required per hour	6,916 lb.
Coal rate per sq. ft. grate per hour	125.4 lb.
Boiler proportions:	
Comb. heat. surface ÷ cylinder hp	1.72
Tractive force ÷ comb. heat. surface	11.29
Tractive force × dia. drivers ÷ comb. heat. surface	768
Cylinder hp. ÷ grate area	38.6
Firebox heat. surface, per cent of evap. heat. surface	6.5
Superheat. surface, per cent of evap. heat. surface	27.9
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	75.1
Weight on drivers ÷ tractive force	4.3
Total weight engine ÷ cylinder hp.	111.3

Bureau of Locomotive Inspection Report

Increase in Defects and Accidents as Compared with Excellent Showing of Preceding Year

THE twelfth annual report to the Interstate Commerce Commission by A. G. Pack, chief inspector of the Bureau of Locomotive Inspection, for the fiscal year ending June 30, 1923, shows a marked increase in the number of defects and accidents due to the abnormal prevailing conditions. An abstract of the report follows:

The percentage of locomotives found defective increased from 48 per cent during the preceding year to 65 per cent, and the total number of defects increased approximately 70 per cent. The deteriorated condition of motive power is sharply reflected in the increased number of accidents and casualties. A comparison of accidents and casualties during the year as compared with the preceding year shows an increase of 117 per cent in the number of accidents, 118 per cent in the number killed, and 120 per cent in the number injured.

Records covering locomotive failures indicate that the number of locomotive miles per locomotive failure decreased as much as from 50 to 70 per cent during the year as compared with the preceding year. Every locomotive failure caused by physical defects carries with it potential injury to persons, serious delay to traffic, and heavy property damage.

During the year there were 57 boiler explosions which resulted in the death of 41 persons and the serious injury of 88 others, an increase of 75 per cent in the number of such explosions, 86 per cent in the number of persons killed, and 93 per cent in the number injured, as compared with the preceding year. While most of these explosions were caused by the crown sheet having become overheated due to low water, the number of such cases where contributory defects or causes were found increased approximately 135 per cent as compared with the preceding year. The contributory causes found clearly establish the necessity for proper inspection and repair of all parts and appliances of the locomotive and tender.

During the year numerous accidents were investigated where welds made by the fusion or autogenous process were involved. The investigations fully support the position pre-

LOCOMOTIVES INSPECTED AND DEFECTS FOUND

	1923	1922	1921	1920
Locomotives reported	70,242	70,070	70,475	69,910
Locomotives inspected	63,657	64,354	60,812	49,471
Locomotives defective	41,150	30,978	30,207	25,529
Percentage inspected found defective	65	48	50	52
Locomotives ordered out of service	7,075	3,089	3,914	3,774

ACCIDENTS CAUSED BY THE FAILURE OF SOME PART OR APPURTENANCE OF THE BOILER

	1923	1922	1921	1920
Number of accidents	509	273	342	439
Number killed	47	25	51	48
Number injured	594	318	379	503

ACCIDENTS CAUSED BY THE FAILURE OF SOME PART OR APPURTENANCE OF THE LOCOMOTIVE AND TENDER, INCLUDING THE BOILER

	1923	1922	1921	1920
Number of accidents	1,348	622	735	843
Number killed	72	33	64	66
Number injured	1,560	709	800	916

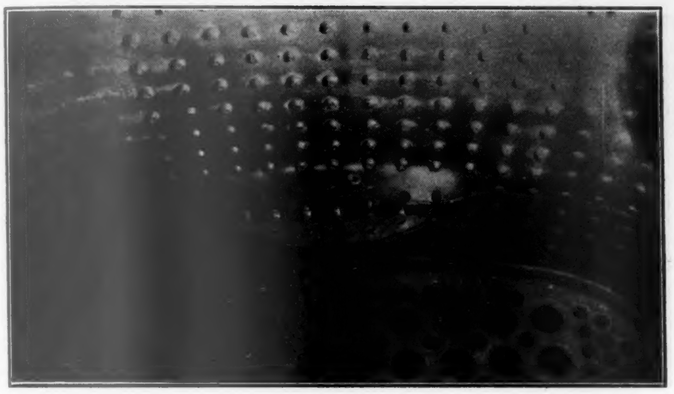
DERAILMENTS AND ACCIDENTS DUE TO DEFECTS IN OR FAILURE OF SOME PART OF THE LOCOMOTIVE OR TENDER

	1923	1922	1921	1920
Number of derailments*	38	22	8	7
Number killed	4	5	..	7
Number injured	157	61	30	18

* Only derailments reported by carriers as being caused by defect in or failure of parts of the locomotive or tender were investigated or counted.

viously taken that this process has not reached a state of development where it can safely be depended upon in boiler construction and repair where the strain to which the structure is subjected is not carried by other construction, nor in firebox crown sheet seams where overheating and failure are liable to occur, or on any part of the locomotive or tender subject to shock or strain where, through failure, accident and injury might result.

Numerous accidents have occurred due to the failure of autogenously welded seams and cracks in the boiler back head. One fatal accident of this nature occurred where an autogenously welded crack 21½ in. long in the boiler back head failed while the locomotive was hauling a passenger train, resulting in death to the engineer and the serious injury of the fireman. The scalding water and steam escaping through the rupture compelled the engineer to leave the cab



Low Water Caused Autogenous Weld to Open Up for 36 In.

without being able to close the throttle or apply the brakes in the usual way. The engineer and fireman climbed out of and around the left side of the cab to the running board and to the front end of the locomotive, where the angle cock was opened and the brakes applied.

Accidents caused by defective grate-shaking apparatus increased from 48 during the preceding year to 138 during the present year, an increase of 187 per cent. The major portion of these accidents were caused by the shaker bar not having a proper fit on the fulcrum lever. Since it is impossible to avoid the changing of shaker bars from one locomotive to

Assortment of Non-Interchangeable Grate Shaker Bars Found at One Small Terminal

another, each carrier should adopt a standard whereby shaker bars are made interchangeable with a proper fit on the fulcrum levers.

Accidents due to the failure of injector steam pipes increased from nine during the preceding year to 40 during the year. A majority of these accidents were due to the injector steam pipe pulling out of the brazing collar due to defective workmanship and to breakage caused by weak, light construction and to defective material. In many instances the failure of injector steam pipes was contributed to by the injector not being properly fastened so as to relieve the steam pipe from the weight and vibration of the injector and its connections.

Accidents which reflect the general condition of driving gear, running gear, etc., increased materially. For instance, main and side rod accidents increased from 23 to 53; valve-gear accidents increased from 18 to 59; and accidents due to failure of reversing gear increased from 53 to 100.

During the year 230 applications were filed for extension

Overheated Crown Sheet Pulled Away from 238 Radial Stays and Pocketed 17½ In. Without Other Material Damage

of time for removal of flues. Investigation disclosed that in 34 cases the condition of the locomotives was such that no extension could be granted. Fourteen were in such condition that the full extension requested could not be authorized, but an extension for a shorter period was allowed. Fourteen extensions were granted after defects disclosed had been repaired. Thirty applications were withdrawn and the remaining 138 were granted.

There were filed 5,076 specification cards and 11,187

Dangerous Condition of Footboard Fastenings on Tender of Switch Engine

alteration reports necessary in determining the safe working pressure and other required data for the boilers represented. These cards and reports were analyzed and corrective measures taken with respect to numerous discrepancies which were found. It was required that many older and weak boilers be reinforced or the working pressure reduced.

In two instances appeals were taken from the decision of inspectors and after careful consideration of existing conditions the appeals were partially sustained and partially dismissed. The decisions of these inspectors were technically in error, but practically correct.

The recommendations for betterment of service made at the close of the report were the same as last year. The following is a brief summary of these recommendations:

That the act of February 17, 1911, be amended to provide

PERSONS KILLED AND INJURED, CLASSIFIED ACCORDING TO OCCUPATIONS

	1923		1922		1921		1920	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
Members of train crews:								
Engineers	19	484	11	213	15	237	16	272
Firemen	16	597	10	277	25	360	20	404
Brakemen	12	137	7	66	13	64	9	77
Conductors	1	35	..	25	2	20	2	19
Switchmen	2	32	1	13	3	15	4	19
Roundhouse and shop employees:								
Boiler makers	3	19	1	10	1	7	2	9
Machinists	2	14	..	9	1	3	1	20
Foremen	1	6	..	1	1	3	..	3
Inspectors	..	2	..	2	..	5	..	1
Watchmen	1	6	..	3	..	4	4	3
Boiler washers	1	9	..	1	..	7	..	13
Hostlers	..	31	..	10	..	8	..	13
Other round house and shop employers	4	29	1	15	1	25	3	30
Other employees	4	36	2	23	2	16	4	26
Non-employees	6	123	..	41	..	21	1	7
Total	72	1,560	33	709	64	800	66	916

ACCIDENTS AND CASUALTIES RESULTING FROM FAILURES OF LOCOMOTIVES AND TENDERS AND THEIR APPURTENANCES

	Year ended June 30								
	1923			1922			1921		
Part of appurtenance	Accidents	Killed	Injured	Accidents	Killed	Injured	Accidents	Killed	Injured
Air reservoirs	6	..	7	3	..	3	1	..	1
Aprons	8	..	8	11	..	11	16	..	16
Arch tubes	12	2	17	4	..	5	5	..	5
Ash-pan blowers	19	..	19	7	..	7	5	..	5
Axles	6	..	7	5	..	17	5	..	6
Blow-off cocks	28	..	29	16	..	16	14	..	14
Boiler checks	12	..	12	4	..	4	7	1	7
Boiler explosions:									
A. Shell explosions	.....	..	.....	1	..	1	...	..	...
B. Crown sheet; low water; no contributory causes found	19	24	27	13	15	23	20	19	26
C. Crown sheet; low water; contributory causes or defects found	34	15	56	14	6	27	33	24	52
D. Firebox; defective stay bolts, crown stays, or sheets	4	2	5	5	1	5	1	2	...
Brakes and brake rigging	27	1	56	10	2	24	6	..	6
Couplers	25	1	27	21	..	23	11	1	13
Crank pins, collars, etc.	12	..	13	10	..	10	6	3	8
Cross heads and guides	10	..	10	4	..	4	4	1	4
Cylinder cocks and rigging	11	..	11	3	..	3	4	..	4
Cylinder heads and steam chests	8	..	8	3	..	3	6	..	6
Draft appliances	13	..	14	6	..	9	8	..	9
Draw gear	16	2	16	7	..	7	8	1	8
Fire doors, levers, etc.	26	..	26	2	..	2	8	..	8
Flues	44	..	59	28	..	32	32	1	35
Flue pockets	2	..	5	1	1	...	1	1	...
Foot boards	36	1	35	11	1	10	8	3	5
Gage cocks	.....	..	.....	2	..	2	...	..	...
Grease cups	6	1	6	3	..	3	7	..	7
Grate shakers	138	..	138	49	..	49	85	..	85
Handholds	34	2	32	12	1	11	19	..	20
Headlights and brackets	8	..	8	2	..	2	8	2	6
Injectors and connections (not including injector steam pipes)	33	..	33	21	..	24	15	2	13
Injector steam pipes	40	..	46	9	..	9	15	..	17
Lubricators and connections	22	..	22	9	..	9	12	..	12
Lubricator glasses	10	..	10	3	..	3	3	..	3
Patch bolts	3	..	3	...	..	...	...	..	...
Pistons and piston rods	14	1	13	6	..	6	3	..	3
Plugs, arch tube and washout	18	3	27	12	1	19	15	..	18
Plugs in firebox sheets	.....	..	.....	2	..	3	2	..	2
Reversing gear	100	..	100	53	..	53	65	..	65
Rivets	5	..	8	...	..	...	4	..	5
Rods, main and side	53	3	57	23	..	27	18	..	21
Safety valves	.....	..	.....	...	..	...	...	..	...
Sanders	4	..	4	2	..	2	...	..	...
Side bearings	.....	..	.....	1	..	1	...	...	...
Springs and spring rigging	25	2	25	10	1	9	3	..	3
Squirt hose	67	..	69	54	..	54	82	..	82
Stay bolts	7	..	8	6	..	8	...	..	...
Steam piping and blowers	19	..	19	9	..	11	9	..	9
Steam valves	16	1	16	6	..	6	11	..	12
Studs	6	..	8	7	..	8	7	..	7
Superheater tubes	10	..	15	...	..	...	1	..	2
Throttle glands	1	..	1	1	..	1	...	..	...
Throttle leaking	6	..	6	3	1	2	3	..	3
Throttle rigging	19	2	19	5	..	5	1	..	1
Trucks, leading, trailing or tender	25	5	101	11	2	25	6	..	8
Valve gear, eccentrics and rods	59	2	59	18	..	18	10	..	10
Water glasses	35	..	35	19	..	19	25	..	25
Water-glass fittings	7	..	7	6	..	6	2	..	2
Wheels	10	1	19	8	1	7	4	1	4
Miscellaneous	170	1	179	61	..	61	91	2	117
Total	1,348	72	1,560	622	33	709	735	64	800

for not less than 50 additional inspectors and increased compensation adequate to carry out the purpose of the law.

That all coal-burning locomotives have mechanically operated fire doors so constructed that they may be operated by pressure of the foot on a pedal or other suitable device.

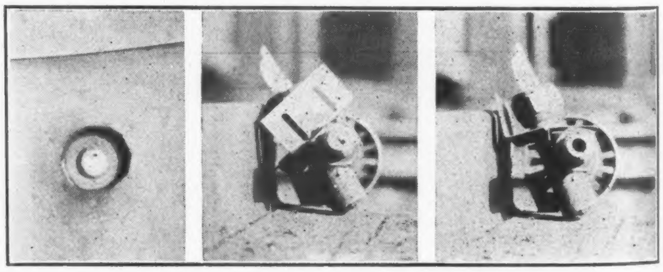
That a power reverse gear be applied to all locomotives.

Two Broken Staybolts With Heads Welded Over and One With Hole Plugged *

That all locomotives be provided with an automatic, power-operated bell ringer.

That the cab of all locomotives not equipped with front doors or windows of such size as to permit of easy exit, have a suitable stirrup or other step and a horizontal handle on each side approximately the full length of the cab.

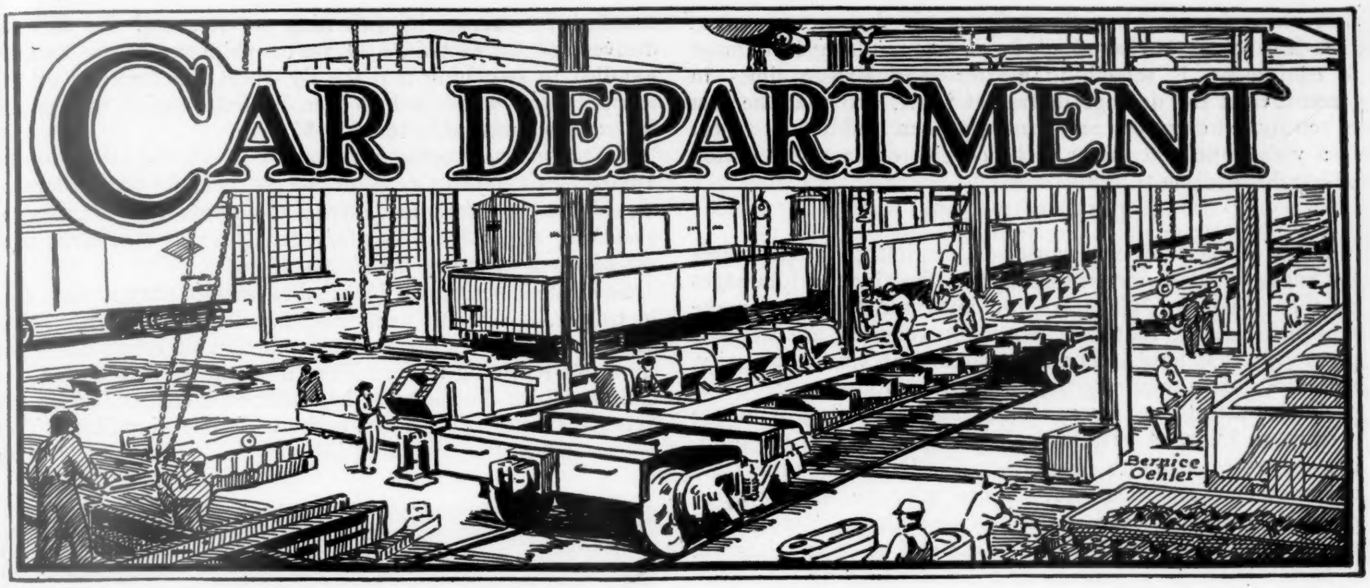
That all locomotives where there is a difference between the readings of the gage cocks and water glass of 2 in. or more under any condition of service, be equipped with a suitable water column, to which shall be attached three gage



Locomotive Was Still in Service, Although Gage Glass Connection Was Practically Closed by Scale

cocks and one water glass, also one water glass with not less than 6 in. clear reading on the left side or back head of the boiler.

HAND BRAKES FOR BRITISH CARS.—By an order made on November 7, 1911, railway companies owning less than 3,000 wagons were given 10 years in which to equip their wagons with brakes on either side; companies having between 3,000 and 20,000 wagons had 15 years, and those with over 20,000 were given 20 years. One result of the recent grouping of the railroads is that while some of the constituent companies had under 20,000, and thus had to complete the work by 1926, under grouping they will get the maximum time.



Car Inspectors' and Car Foremen's Convention

Conclusion of 1923 Convention Report—More of the Papers and Discussion of Billing Rules

A GENERAL report of the convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, held in Chicago, October 3, 4 and 5, was given in the December issue of the *Railway Mechanical Engineer.* Included in this report was the discussion on Interchange Rules and the paper on Lubrication. Other papers and discussions follow. More will appear next month.

Prevention of Loss and Damage to Freight

By T. A. Ward

District Freight Claim Agent, New York Central

One of the most strikingly successful campaigns of any kind, for increased efficiency, ever carried on by the railroads of this country has been the campaign that they have been waging, and are still waging, to reduce loss and damage to freight and the resulting claims that must be paid.

In spite of this fact the direct losses sustained by the railroads from the inadequate conditioning of goods, as well as from the improper handling of goods while in transit, has in recent years averaged from fifty to one hundred million dollars annually; and to this great loss may properly be added measureless amounts sustained directly or indirectly by producers and consumers through failure adequately to prepare shipments, so that with reasonable handling by the railroads they will reach their destination in sound condition.

Those who discover irregularities, or acts of carelessness in freight handling, and neglect to correct them, or who permit losses or damages to continue without effort to remove the cause, are, unintentionally, perhaps, but surely retarding their own progress, as well as aiding in the continuance of that which others are striving to remove—the avoidable causes for loss and damage to freight.

Daily observation would indicate that at least 40 per cent of the cars actually transferred is on account of improper inspection at the originating point, where cars should have been repaired and placed in fit condition before being loaded, and that at least 60 per cent of the loads adjusted is due to improper cooperage at doorways of cars, cars too weak to withstand the service; a large number of cars having no cooperage whatever to protect the lading, and on open cars improper blocking and staking, coal cars with defective hoppers and doors which have not been properly closed at the mines or in transit.

Loading defective cars before they have been inspected by inspector at the warehouse is a very serious matter. A car might have been all right for the commodity brought in, but not for the outbound shipment. Every car at the warehouse should be inspected after unloading, and markings religiously observed. We are bound to have man failures and some defects cannot be detected by visual inspection. Closed door inspection is made to determine whether there is a ray of light coming through at any point.

Recently I went through some of our yards in a study of hump and flat yard switching, but came out quickly when some cars came together, and I can assure you that it was not at the rate of two or three miles per hour.

Twenty-three million dollars was the cost to the principal railroads of the United States last year in freight claims, because of rough handling of cars, derailments, delay and unlocated damage, and these four causes alone were responsible for almost half of the entire loss and damage bill.

Personally, I do not look upon rough handling of cars as a difficult thing to overcome. We know that most of this is occurring in the yards and there is no good reason to my mind why it cannot be practically, if not entirely, eliminated.

I believe we should make personal appeals to all enginemen and yard men to do what they can to eliminate entirely rough handling and endeavor to build up within them a feeling of interest and a spirit of loyalty, but we must go further and see that instructions given are literally complied with and then give the question of rough handling full and proper supervision at all times.

I cannot think of a more practical plan than to work with the men who actually handle the cars. I am frank in saying that it is my personal opinion that this all-important subject has not yet reached the attention it deserves. I am afraid that a great deal, which has been written and said on this subject, has failed to reach the men who actually perform the work and that sufficient pressure has not yet been brought to

bear, in order to bring about the result that we are after.

It has been said that rough handling, resulting in damage to equipment, is something greater than sixteen times in amount than the damage to freight itself, and that the cost of setting out crippled cars, handling them, and delay to them is a very important factor to be considered in this question of rough handling.

Delay to Freight

Delay of itself not only causes claims, but greatly increases the hazard of theft, deterioration, fire, freezing, and damages by the elements. Therefore, we must see that cars make scheduled trains; that cars requiring weighing are weighed promptly; that hold tracks are switched at least once daily, and that loads requiring repair track movement are given preferred attention. Proper chalking or carding, and the prompt and correct handling of waybills are also essential, if costly delays are to be prevented. Diversion orders require special attention that change may be accomplished promptly and car moved in accordance with the new instructions and to avoid rehandling, delay and resultant damage.

In talking with a general foreman not long ago, he said, "Any number of cases have been brought to my attention where wheels are applied with rusty journals and many more with dents in the journals caused by wheels coming in contact with flanges. These cars run without causing any trouble while they are empty, and many times are overlooked when they come home, but they will show up a hot box when they are loaded and are placed in fast trains."

Again he said, "I was called to make an inspection of a car where the water was dripping through the roof, the roof seeming to be in good condition, there was no apparent reason why this condition should exist. Upon making a closer inspection and having some of the roof boards removed, I found the entire top course of roof boards were applied new, but the old roof paper was left on, which was worn out and the new roof boards were spliced in fifty-six different places. As a result, the entire insulation on this car was water soaked, which necessitated the renewal of the entire roof, ceiling included, not mentioning what happened to the side walls."

The gentlemen who are in the yards most of the time ought to appreciate the difficulties experienced in connection with open-top cars, particularly the hopper type, loaded with bituminous coal. One prominent terminal was handling about five hundred such cars every 24 hours, and those in charge are frequently obliged to arrange for the adjustment of about 50 cars in every 24 hours, due to the bad condition of the hoppers, corrosion and, in some instances, the hoppers not properly pulled up and closed at the point of loading.

A serious condition, as I have noted from time to time, is the lack of energetic methods in handling cars in our terminals for re-icing, when they are condemned for defects. It should be impressed upon the minds of all concerned that perishable freight, particularly under refrigeration, should be treated the same as passenger service. As witnessed in my own visits, some of these cars are sandwiched in with other cars in the train yards at terminals and a serious delay occurs, while to my mind they should not be lost sight of by the yard department or agent, under any circumstances, while being held, particularly in extreme weather. You know how many large claims arise from this source, due to 12 to 36 hours' delay at terminals, which should be overcome through some systematic method.

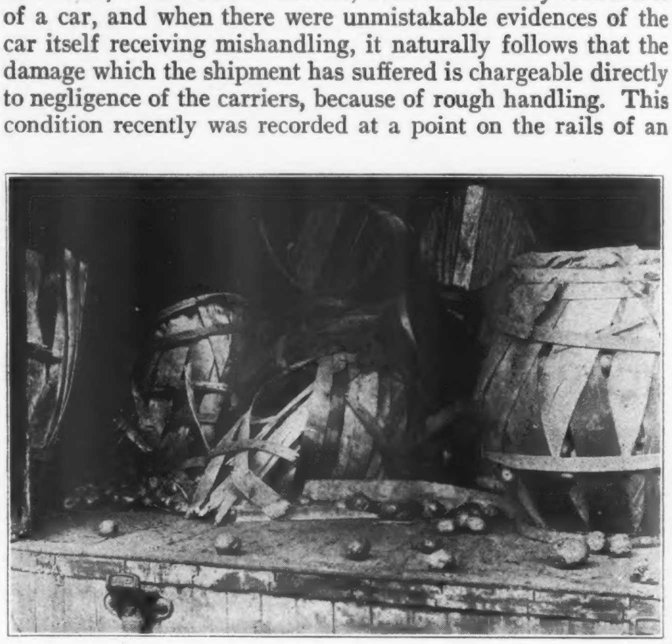
Your help has enabled the carriers to reduce loss and damage considerably during the past year, but there is much more work still to do, and with your assistance we hope to cut down freight loss and damage to the very bone. If we all get into the game wholeheartedly, we can prevent this waste which, directly or indirectly, is a burden upon everyone.

With your permission, I will relate several claims the carriers were obliged to pay during recent months:

Shipments of machinery including an 8-ft. fly wheel, only handled by carrier in switching service, and the revenue derived did not exceed $5.00, yet the shipment was so roughly handled in switching that the fly wheel was knocked off the flat car upon which it had been loaded, causing an expense for repairs amounting to $529.82.

Shipments of machinery, because of their bulk, must be handled as carefully as other freight, and the very nature of the commodity does not extend to anyone the privilege of switching at a higher rate of speed than is consistent with the physical safety of the shipment.

Sheet steel, because of its oiled surface to prevent rust, etc., in transit, is difficult to handle, even in ordinary movement of a car, and when there were unmistakable evidences of the car itself receiving mishandling, it naturally follows that the damage which the shipment has suffered is chargeable directly to negligence of the carriers, because of rough handling. This condition recently was recorded at a point on the rails of an eastern carrier, and, in order to reduce the damage to a minimum, the shipment was returned to the shippers, and the cost of reconditioning totaled $1,969.67.



An Example of Unfit Containers, Poor Loading and No Bracing

A consignment of machinery including grinders, countershafts, etc., properly braced in car to withstand ordinary handling was accepted for movement, and freight charges of $70.09 assessed on the total tonnage of 24,000 lb. When the shipment reached its destination, the machines had been tipped over and badly damaged, the car bearing evidence of mishandling by the carriers. The total cost of repairs was $2,689.89.

Loaded freight cars regardless of their contents should be handled as carefully as a stock of dynamite.

Claim representing damage to shipment of 189 coils of iron wire, moving between two eastern points. This being a carload shipment, it developed that the car was assigned by the receiving clerk to the shippers without proper inspection of the equipment being made to see if it was suitable for this commodity. Car had previously contained salt, was not properly cleaned after unloading, resulting in wire corroding and rendering same unfit for use.

A few minutes of receiving clerk's time spent in proper inspection of the car would have saved carriers $1,269.00.

Discussion

T. J. O'Donnell (Buffalo, N. Y.): When you, as operating men, show a cost per car to your general superintendent, do you realize that cost per car is partially eaten up at the other end of the line by freight claims? When you reduce cost one or two cents a car by five-mile switching, somebody has to pay for it, and the railroad handling that car is the one that pays. I often wonder if our big operating officers realize that, in reducing the cost per car, by taking off car

riders, by hurrying the yard department force, by patting the yardmaster on the back, they are wasting money in some other way.

For the last three years it has been almost impossible to handle cars through our gateway into Canada without transferring at least 20 or 25 cars a day, due to the hoppers being open from three to nine inches, and you cannot do anything with them, due to lack of care at the point of loading. I contend there should be more positive inspection at the gateway of the mines when the equipment is given to the railroad to pull to its destination. That is the place to condemn the car and see if we cannot start it out on its five or six hundred miles in a serviceable condition.

Rough handling of cars and defective equipment mean a transfer of about 800 cars a month out of 350,000 cars, but I am happy to say that our freight equipment, at the present time, is about 30 or 40 per cent better than it was three years ago. We very rarely now run into a 30-ton wooden underframe car.

C. C. Stone (Southern): I would like to ask Mr. Ward if it is not true that initial specification does make the shipper partly responsible for the condition of the car when loaded? The reason I speak of that, a lot of industries order a car for rough freight and take the same car and load it with a finished product. Later, we will get a claim, and the car department has not had an opportunity to inspect the lading.

Good Bracing But Uprights Too Short; Surface Tiers Braced by One Piece of 2-in. by 4-in. Lumber Not Securely Nailed; Load Shifted

Mr. Ward: If the shipper has not given the railroad an opportunity to inspect the lading we would not pay such a claim as that, and I do not believe any other carrier would be forced to pay it. Some carriers might pay a claim like that for policy reasons or something of that kind, but we would not.

W. R. Rogers (Youngstown, Ohio): In selecting cars, we do it in accordance with the supply and demand. If we have a good supply, we give you a good car. If we haven't a good supply, we do the next best thing.

Mr. Ward: That is wrong. You are hurting our claims and you are hurting the operation.

Mr. Rogers: You want the business.

Mr. Ward: No, we don't. We don't want to load a car that is unfit to be loaded. We might get $25 revenue and lose $2,000 in claims. We might better wait to get a car that would carry that load safely to its destination. Any car man who will deliberately say he did not have a car which would carry the load safely, but he took the next best thing, is making a serious mistake.

Mr. Rogers: You misunderstand me. I do not want to take a car for grain without a roof, but the time comes when we haven't a car for 100 per cent loading. Isn't it better to have an inspection at the originating point than to have none, and thereby pro rate the expense of the claim?

Mr. Ward: I would not advocate that at all. That would be contrary to what I am preaching.

E. G. Chenoweth (C. R. I. & P.): I would like to say a word in defense of Mr. Rogers. The claim department, of course, has the idea that we should load cars, in order that there will be no claims or no liability of claims. Now, we know, it is not always possible to furnish A1 cars for the commodity called for, and, therefore, we do the next best thing. While we are more apt to get claims, we are not liable to get claims for every car that we furnish. As the demand gets greater and the car shortage gets greater, we are liable to furnish a less efficient car.

The Rock Island is a grain railroad, and, in following this up all summer, I know we picked A1 cars. We used the flour cars or cement cars for grain, but if we did not have those cars, we surely did not let the loads get away. We used other cars, even if they required double cooperage, and, therefore, while the claim department might say we were disobeying orders, I rather question that statement.

Mr. Zachretz: We card cars for the commodity for which they are supposed to be loaded. We even take cars marked "rough freight" and allow them to go west loaded with rough freight, and when they come back the rough freight tags are still on and they are loaded with grain. Now, how is the car department responsible for that? As mechanical men, all we can do is to see that the cars are properly side carded for the commodity for which they are supposed to be loaded. If they are loaded with some more particular commodity, than I think the freight claim department should get after other departments. They should get after the operating men. They should instruct the agents that when they have a car to be loaded and it is properly marked for rough freight only, they must see that it is not loaded with flour, that it is not loaded with grain. They must see that it is not loaded with anything liable to leakage or damage by moisture.

Mr. Campbell: The proper position of door protection for flour cars is not up to the car department. In the milling district in Minneapolis, where we load about four hundred cars a day, the Western Grain Bureau entered into an agreement with the milling companies whereby it was not necessary to put door protection in the cars. They found they got better results by pyramiding the flour in the car than they did when they had side door protection.

Paper by A. J. Mitchner

[A. J. Mitchner's paper on Car Inspection which won the first prize offered by the *Railway Mechanical Engineer* (see the May, 1923, issue) was read at this point and then discussed as follows:—Editor.]

Jos. Dyer (Youngstown, Ohio): There is one point I would like to have brought out in connection with the report just read, and that is, does a cracked wheel and other live defects show more on a certain type of car?

A. J. Mitchner (M. C.): The defective cracked wheel is caused by the brake striking in the majority of cases. Nine times out of ten it is cracked in the plate, sometimes on the tread. We have also found wheels bursted. That is usually caused by an error in the axle fit.

Chairman Armstrong: I have had much to do in my time with hot boxes, which seem to be receiving considerable attention at this session, and I have seen the time when possibly we might have used very nearly the amount of oil that our friend, Mr. Charlton, said they used, but I am wonder-

ing if he wants us to go home and tell our people that he is using a half pint of free oil to each box.

A. J. Charlton (O. S. N.): I do not mean that we put it in every box; only where it is required. We find some boxes with the packing dry enough to wipe your hands on, and those are the boxes we oil. We find other boxes that have too much.

Paper by Wm. J. Owens

[Wm. J. Owens' paper on Car Inspection which won the *Railway Mechanical Engineer* second prize (see the May, 1923, issue) was read at this point and owing to lack of time there was no discussion.—Editor.]

Questions and Interpretations

Question Box Committee

A. Herbster (N. Y. C.): Before the questions and interpretations are read may I ask if these recommendations will go to the A.R.A. Committee, or will they be followed by the rank and file, in billing?

Chairman Armstrong: Those which Mr. Jamison spoke of as recommendations will now be read and no interpretation issued. We cannot issue an interpretation on a recommendation.

Both questions and answers were read by B. F. Jamison (Southern), chairman of the committee, as follows:

Rule 17—P Triples on Freight Cars

Interpretation 15, following Rule 17, states that triple valves having removable check valve cases are convertible to K type. P-1 and P-2 triple valves have removable check valve cases.

Q.—Should they be considered convertible?

A.—P-1 and P-2 triple valves are not convertible. These valves are for passenger equipment, and Rule 17, Interpretation 15, covers repairs to freight equipment. If a railroad makes use of this type of triple on freight equipment, they will have to be governed by the freight rules. See Supplement No. 1, Item 57-U, 1922 Code.

Mr. O'Donnell (Buffalo): I move that this interpretation be accepted.

The motion was duly seconded and passed.

Car with Worn Flange Derailed and Damaged

Foreign car derailed at *A* end—*B* end not derailed—; cause of derailment "worn flange wheel." When car had been rerailed, it was found to have the following defects, which did not exist previous to the derailment: Brake beam and brake rigging broken at *A* end; truck side bent at *A* end.

Q.—When repairs are made, how should the bill be rendered?

A.—Car owners should be billed with renewal of the wheel, material and labor. The billing repair card for other repairs should be marked "No bill."

The interpretation as rendered was accepted.

M. J. E. Mehan (C. M. & St. P.): I do not think the decision of the committee is correct. As I understand the question, there was a derailment. There was the worn wheel and the damaged truck side, which are at the same end of the car, and if that is true, the damaged truck side has to be taken off, which consumed the labor of the wheel change. Therefore, the labor of the wheel change cannot be charged.

W. W. Wilson (C. & O.): I cannot agree with our friend from Milwaukee, in that the labor would not be applicable in this case because Rule 65 shows where it is a delivering line defect for wheels or axles. There are three arbitration cases, one in particular, if I remember correctly, No. 697. That was rendered in back years, but there are two later cases, No. 1138 and 1156, as well as Rule 42, which at the present time divide the responsibility, whether owner's, or delivering line's, and the committee has always decided that the cause of the derailment is properly charged to the car owner, only if the car has been jacked for the broken frame. I will agree with Mr. Mehan that we cannot charge, because the "Jack Case Decision, No. 1042," states that the delivering line defect shall be the primary cause for removal, and the labor for jacking is not chargeable to the car owner.

Mr. Jamison: Mr. President, the committee agrees that the labor should be charged to the truck side. That is assumed as a responsibility in so far as it is covered in that way and, with the permission of the association we will make that decision so read.

A motion to accept the interpretation was carried.

Rule 33—Safety Appliances

Q.—In view of interpretation under this rule and Arbitration Decision 1277, are the repairs to safety appliances, such as handholds, sillsteps, uncoupling levers and brake shafts, chargeable to the car owner when such are damaged by derailment and not involved with other delivering line damage?

A.—Can be charged when no other delivering line defect exists.

No objection was entered on this decision.

Rule 60—Cleaning Brakes

Rule No. 60, with interpretations, provides that charge cannot be made for the second cleaning of air brakes on the same car, on the same line, within 60 days from the date of the first cleaning.

Q.—Could charge be made for a third cleaning of the air brakes on the same car and road, providing the third cleaning was within 60 days from the second cleaning for which no charge was made, but more than 60 days from the date of the first cleaning?

A.—No charge can be made for such a third or subsequent cleaning. It is simply an evidence that the work has not been correctly performed.

Mr. Jamison: I would like to say that someone spoke a moment ago about the questions not being in proper form. That is the difficulty I have experienced with most all questions I have received, not only for the purpose of this committee handling, but for handling in my own work. As a rule, the person asking a question only gives you meager information, and the committee has borne that in mind, and attempted to give only a general answer, based entirely on the information given. You have no right to assume there is anything else done or not done, when there is any other condition than that which is stated plainly in the question. The following question does not sound very clear, but I understand what is wanted.

Brake Cylinder Gaskets and Bolts

Q.—When a brake cylinder gasket is applied, it is found necessary to renew the brake cylinder bolt, securing the cylinder to the brake cylinder block, account of these bolts being broken on arrival of the car at the shop. Can additional labor be charged?

The questioner means that we get a charge of 93 cents labor for applying a brake cylinder gasket. The detailed statement following that 93 cents, it is anticipated that you would remove the reservoir, which consists of two bolts holding the reservoir to the reservoir block. Now, it is often found that the bolts holding the brake cylinder are broken, and the questioner wants to know if, when these bolts are broken and he has to renew them, he can make an additional charge.

A.—Yes, charge regular bolt labor, as per Rule 107, Items 90 and 91.

The interpretation was accepted.

Charge for Wrong Wheels

A car offered in interchange, stenciled for steel wheels, is found to be equipped with one pair cast iron wheels covered by defect card. The receiving road finds it necessary to renew the cast iron wheels on account of being defective and also finds it necessary to perpetuate wrong repairs by applying cast iron wheels on account of having no steel wheels in stock.

Q.—Is the road that originally carded for the wrong wheels or the road that perpetuated the wrong wheels responsible to the car owner; also what charge, if any, should be made for the application of cast iron wheels at the time wrong repairs were perpetuated?

A.—The intermediate line not applying the steel wheels is in no way responsible for the wrong repairs that were made to the car, as the defect card attached to the car assumes the responsibility of the wrong repairs mentioned, and the charge for cast wheels applied in accordance with Rules 101 and 107 is correct, leaving the defect card on car.

The interpretation was accepted.

Rule 91—Date of Bill for Wrong Repairs

Rule 91 provides that bills rendered one year after date of repairs may be declined.

Q.—Should not the same principle apply in cases of wrong repairs corrected and billing repair card 90 days in possession of car owner and not presented to repairing company for defect card within 90 days after the expiration of a 90 day time limit to match joint evidence card with billing repair card.

A.—Rule 91, second paragraph of Section *A* applies.

The interpretation was accepted.

Change in Type of Triple Valve

Q.—What would be the proper charge for the difference in value of triple valves in the following case:

Non-convertible triple removed.
K-type standard triple applied.
Car stenciled "K type standard" (K-1 or K-2).
Car built January, 1914?

A.—The proper charge in such a case should be $31.40 less a scrap credit of $1 plus the labor charge for cleaning. This is a case of the correction of improper repairs, and comes under Supplement 1, Item 57-P, 1922 code.

Mr. Herbster: Why put the extra charge of cleaning when you consider the triple valve scrapped? The triple valve applied must certainly be cleaned when being applied.

Mr. Jamison: This particular question does not apply to the labor at all. It was merely the question of the difference in the value of the two triple valves. The labor of cleaning is not concerned in the question at all.

Mr. Watkins: Item 57-D says: "Non-convertible on cars built prior to January, 1915, $11.50, with no credit."

Mr. Jamison: The kind of triple valve removed is the non-convertible on a car built prior to January, 1915. That is exactly what this question considered, but if you look at the top of the column, it says, "This triple valve was the kind that was removed when the car was stenciled for same." What kind of a triple valve? A non-convertible valve, or not stenciled at all. But in this case a car was stenciled "K type standard"; therefore, it became a question of correcting wrong repairs and not adding a betterment to the car.

Mr. Watkins: I stand corrected.

Mr. Martin: In answer to Mr. Herbster, as to why it should be necessary to make that labor charge, I believe the rule provides it is necessary to clean the valve as well as the cylinder; if you clean the cylinder, you have to charge for the new valve applied.

Mr. Herbster: That is correct, but the clause should be made that the charge is for cleaning the cylinder and not the triple, so as not to be misleading.

Mr. Jamison: The charge you make for the difference in the triple valve is like the charge you make for an angle cock or a retainer valve; it is not the price of a new article; it is the price of a good article in good condition, and Rule 17 says, in these cases, that the difference in value of the triple valve shall be charged, plus the labor charge of Rule 111, Item 9, $4.22, at the present time. You cannot get away from that.

A motion to accept the interpretation was carried.

Rule 101, Item 140—Coupler Parts

Q.—What is the proper charge for coupler release rod clevis, clevis pin and cotter?

A.—Seventeen cents net, applied to the car, as per Rule 101, Item 140.

Rules 107 and 111—Hand Rail

Q.—How should repairs to hand railings on cars be charged, where such railings are wholly or partly constructed of pipe?

A.—Charge for pipe connections, and the cutting of pipe threads may be charged as per Rule 111. Other operations according to Rule 107.

Chairman Armstrong: If there are no objections, these interpretations will be accepted.

Rule 107—Brake Beam and Bottom Rod

Rule 107, Item 237: Q.—What charge can be made for applying a brake beam tension nut when the beam is not removed?

A.—One-tenth (1/10) hour, as per Item 237, Rule 107, 1922 Code.

The interpretation was accepted.

Rule 107, Item 90: Q.—It is invariably necessary to R. & R. three key bolts when bottom brake rod is R. & R.; is it not proper to charge for the three bolts per Item 90, Rule 107?

A.—The charge shall be confined to key bolts passing through the bottom rod.

Mr. Straub: I move that be rejected.

Chairman Armstrong: State your objections.

Mr. Straub: Because it is necessary to R. & R. three key bolts when you put in a bottom brake rod, nine cases out of ten, so why shouldn't we get paid for it?

Mr. Jamison: I tried to get that two-tenths of an hour for so long I had to give up. If your bottom brake rod is broken and you apply a new brake rod, it is your duty to see that the brakes are properly adjusted; and to adjust your brakes properly, you are going to have to R. & R. your dead lever key bolt, and it is covered by Rule 108.

A motion to accept the interpretation was carried.

Rule 21—Transverse Tie Rod

Rule 21 does not specify the manner in which temporary transverse tie rod shall be applied.

Q.—Should not the repairing road be the judge and charge according to Item 262, Rule 107?

A.—Yes.

Q.—Also should not Rule 21 show "applies only to open top cars?"

A.—No.

It is the understanding of the committee that Rule 31 refers to any kind of a car that needs a temporary transverse tie rod.

Both interpretations were accepted.

Rule 107, Item 254—Release Lever

Q.—What is the proper labor charge for a Carmer (two piece) release lever?

A.—The charge is specifically covered by Item 254, Rule 107, which is eight-tenths of an hour.

The interpretation was accepted.

Rules 101 and 107—Coupler Lock Lift

Q.—What is the proper charge for removing and replacing a coupler lock lift on account of being improperly applied?

I think the questioner was thinking about what we know to be a "stay right," which is secured by a nut, the "stay right" itself being a sort of eye bolt passing through the coupler release lever and secured by a nut. Then the pig tail, as the boys call it, comes down and curls through the lock lift and knuckle lock lift. A great many people put that on backwards, and then the motion of the car going over the road jostles it around so that it must be disconnected and put in right.

A.—On a nut basis.

Rules 101 and 111—Air Brake Work

Rules 101 and 111: Q.—What charge should be allowed for renewing a Wabco packing, this being standard to car, yet it is not a packing leather as mentioned in Item 29, Rule 111.

A.—No charge should be made when the air brakes are not cleaned.

Rule 111. Q.—What is the proper charge for the renewal of a cylinder gasket when the air brakes are not cleaned? The car is so constructed that it is necessary to remove the cylinder from the car to apply the gasket.

Now, this sort of pertains to a question we had a little while ago, and yet it is different. That is the question of the brake cylinder bolt breaking, on account of having to be removed, but in this case your car is so constructed you have to remove the cylinder in place of the reservoir, as is anticipated in Item 11, of Rule 111, it allows us ninety-three cents for renewing a brake cylinder gasket. It is an arbitrary charge specifically covered.

A.—Charge per Rule 111, Item 11.

Conflict, Rules 60 and 90

Rule 60, Interpretation 3, conflicts with Rule 90.

Q.—Which shall govern? A.—There is no confliction, both rules should govern cases referred to.

Chairman Armstrong: Unless there is objection, these interpretations are accepted.

Rule 107—Replacing Arch Bar in Place

Rule 107 (second reading): Q.—What is the proper charge to car owner for repairing a top arch bar in place, when the top arch bar is heated, car jacked and one column nut is applied?

A.—Charge for jacking the car and one nut; that is, labor and material charge for one nut.

[A long discussion of this answer developed the opinion that arch bars should be removed for straightening and the discussion was closed by the Chair as follows:]

Chairman Armstrong: I think it is the intention to hold but one more session and you will realize, then, that I won't have authority much longer, so I am going to take the reins in my hands and say you are either going to take those arch bars off and take them back to the blacksmith shop and have them straightened, or else you are going to confine yourself to the nut charge. (Applause.)

Derailment and Broken Flange

Q.—In case of derailment and you have a broken flange on a wheel with a worn tread or sharp flange, is it proper to charge renewal to car owner?

A.—The initial cause of damage, if an owner's defect, should be billed for, but no subsequent damage should be billed for.

M. J. E. Mehan (C. M. & St. P.): I do not think that answer is correct, as I understand the flange of the wheel was broken in derailment.

Chairman Armstrong: He did not say so, as I understand it.

Mr. Mehan: I think that question presupposes that the broken flange was caused in the derailment. I would so take it from the reading of the question, and, if that is correct, we cannot charge for that wheel at all, even though it was worn out, because the Arbitration Committee has ruled in a case of a worn out wheel. Even though the wheel had given all its life in fair service and had been slid afterwards, the committee ruled that the sliding of the wheels must be the predominant defect, and the fact that the wheel was worn out must be disregarded.

Mr. Sternberg: With the information given the committee I think their answer is correct. The question does not say whether the flange was broken after derailment or before.

Mr. Pyle: I might state that the committee had in mind that it was due to the sharp flange when they rendered their decision.

Rules 87 and 88—Defective Material Renewed on Repairs

Q.—If car owner removes defective material in making repairs, on authority of defect card, shall charge be made for material and labor?

A.—Charge should be made for both material and labor, governed by the provisions of Rules 87 and 88, credit to be allowed for such second-hand material removed as covered by Rule 122.

The interpretation was accepted.

Rule 70—Wheels

Rule 70 (second reading): Q.—ABC railroad delivers a car belonging to an intermediate line railroad to XYZ. On inspection on interchange, a car is found stenciled, "Equipped with Steel Wheels." The car, however, is found to have three pairs steel tired wheels and one pair of cast steel wheels. XYZ railroad demands a defect card from delivering line for one pair cast steel wheels in place of steel tired wheels, under Rule 70.

A.—A defect card is not in order. The car owner has failed to protect the equipment by showing that it is intended that the car should be equipped with steel tired wheels and Rule 70 does not apply.

This interpretation was accepted.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Safety Appliances Damaged in Derailment

On March 27, 1923, Bessemer & Lake Erie Car 41569 was pushed off the end of a switch on the Baltimore & Ohio, which resulted in damage to the truck and safety appliances. The Baltimore & Ohio made complete repairs at its Connellsville shops on April 4, 1922. The cost for the truck repairs was absorbed by the handling line, according to Rule 32, but a bill was rendered against the owner for the cost of repairing the safety appliances, according to Rule 33. The Bessemer objected to the bill for safety appliance defects on the ground that Rule 32 provides that the delivering company is responsible for defects caused by a derailment.

The Baltimore & Ohio took the position that hand-holds, sill steps, grab irons, brake staffs and other similar items are invariably damaged through some form of Rule 32 conditions, and it contended that the above items were properly billable against the owner.

The Arbitration Committee decided that, "Interchange Rule 33 would not apply in this case, therefore the charge for repairs to safety appliances should be cancelled."—*Arbitration Case No.* 1277, *Bessemer & Lake Erie vs. Baltimore & Ohio.*

Damaged Car Moved From Owner to Handling Line and Back

On February 15, 1922, Missouri Pacific car 73362 was received in interchange at Fort Gibson, Okla., by the St. Louis-San Francisco. Neither company maintains mechanical inspectors at this point. The conductor and agent of the St. Louis-San Francisco noticed that the car had slid flat wheels, but in order to avoid delay to a loaded car, they decided to move it to Muskogee, Okla., where it could be unloaded and then sent back to the owner at the point of receipt. This car was again offered in interchange at Fort Gibson on February 25, 1922, with four pairs of slid flat wheels, and the interchange was signed by the Missouri Pacific's agent on the same day. On February 27, the Missouri Pacific sent a car inspector from another point to make inspection of this car on the interchange track. After this inspection was made, he demanded a defect card covering the four pairs of flat wheels from the agent of the St. Louis-San Francisco. The agent refused to issue a defect card, claiming that the wheels were slid flat when the car was received from the Missouri Pacific on February 15.

The Arbitration Committee decided that "the position of the Missouri Pacific is sustained. If the slid wheels existed when the car was offered to the St. Louis-San Francisco, the latter company should have demanded and obtained a defect card from the delivering company."—*Case No.* 1,276, *St. Louis-San Francisco vs. Missouri Pacific.*

Defect Cars Repudiated

TARX tank car No. 2, the property of the Allied Refining Company, arrived at the Okmulgee, Okla., plant of the owner May 23, 1922, with a broken outlet nozzle and a broken oil box, L 4. At that time the car was bearing defect card No. 20, issued by the St. Louis-San Francisco at Okmulgee, Okla., "one broken outlet nozzle." The car, not being in condition for service with the defect as enumerated, it was ordered to the shops of the Peoples Tank Line Company, Coffeyville, Kans. The car was repaired and a bill was rendered against the Allied Refining Company. The St. Louis-San Francisco defect card was removed while the car was in transit from Okmulgee to Coffeyville, and the charges covering the cost of repairs were absorbed by the Allied Refining Company. A bill was presented to the St. Louis-San Francisco by the Allied Refining Company, but the road repudiated it, claiming that there was no record of the car receiving unfair usage and the card had been applied to the car through misinterpretation of the rules by the car inspector at Okmulgee. The Allied Refining Company contended that the handling line had no right to repudiate the defect card and that there was every indication that the car had been involved in a derailment. This claim was further substantiated by a joint inspection made at that time.

The Arbitration Committee rendered the following decision: "The St. Louis-San Francisco should not have removed its defect card, therefore the car owner is entitled to the same in accordance with the rules."—*Case No.* 1,275, *St. Louis-San Francisco vs. Allied Refining Company.*

One of 30 New Sleeping Cars Built by the Canadian Car & Foundry Company for the Canadian National

New Canadian National Sleeping Cars

Distinctive Floor Plan Arrangement—Frame and Exterior of Steel; Interior Finished with Wood

DURING the latter part of 1923 the Canadian National received from the Canadian Car & Foundry Company, Montreal, Que., 30 sleeping cars for use in trans-continental trains, in the design of which special attention has been given to the comfort of long distance travelers. The cars are of steel frame construction with fish-belly center sills. They are finished in steel outside, except for a wood and canvas roof, and in wood on the interior.

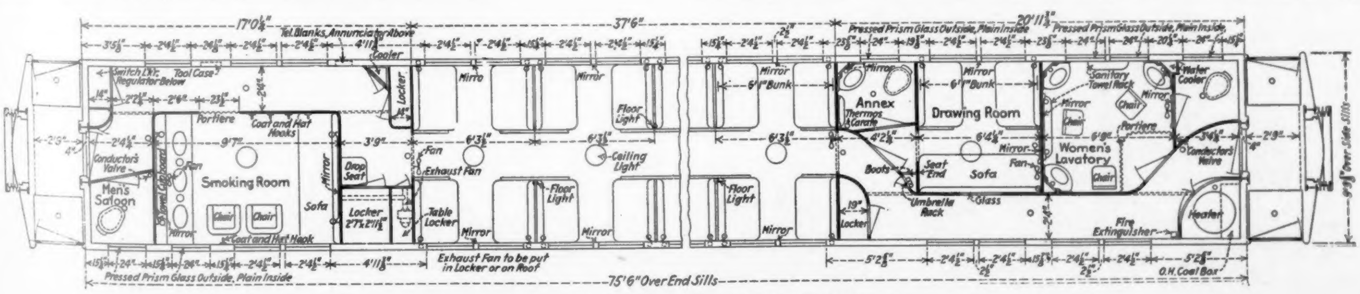
Interior of the Ladies' Dressing Room

The Interior Arrangement

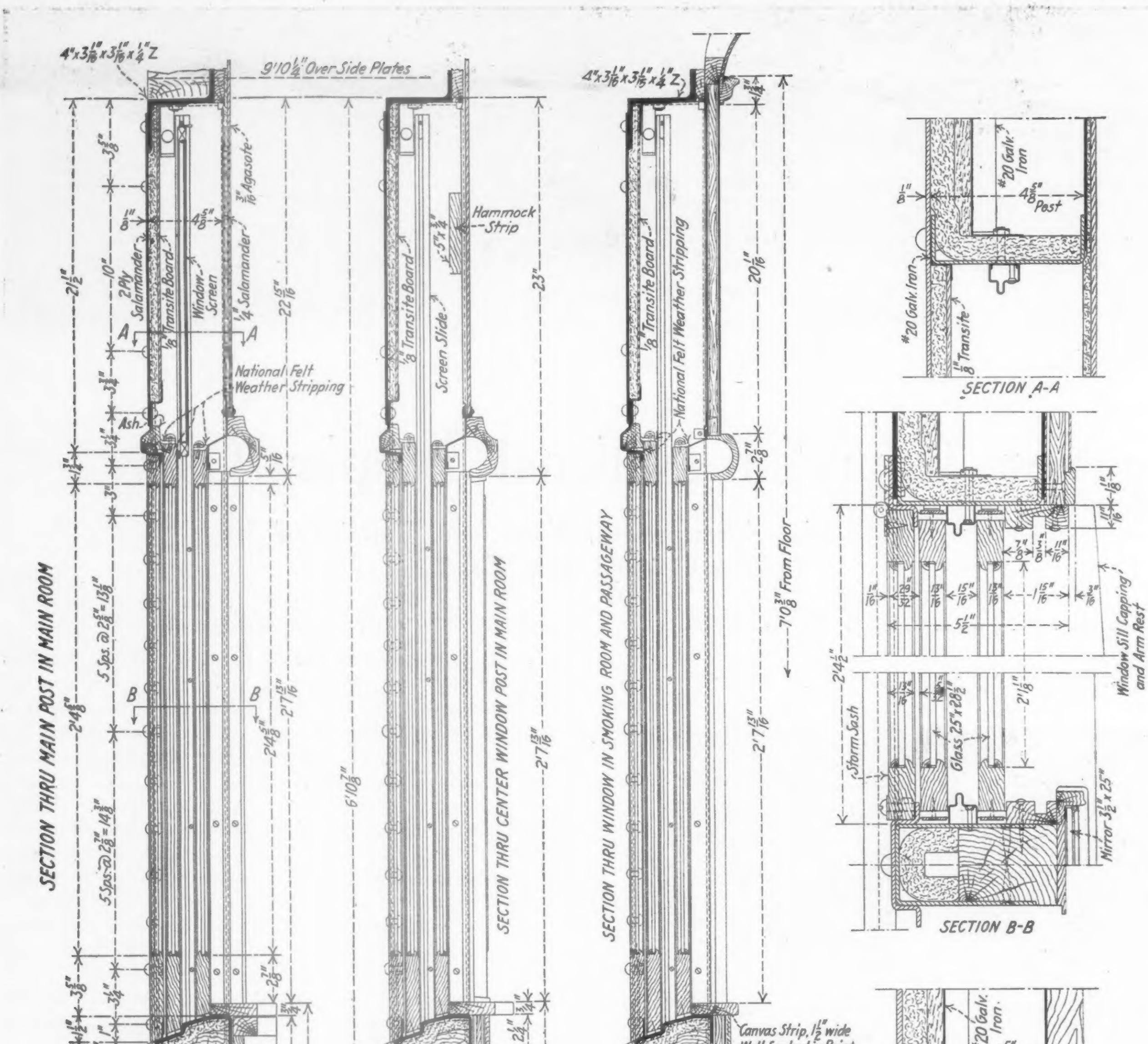
The most interesting features of the new cars are the floor plan arrangement and the special facilities for the comfort and convenience of the traveler. The floor plan is shown in one of the drawings. The cars are 75 ft. 6 in. long over the end sills, about 2 ft. longer than the older equipment, and are provided with twelve sections, which are 6 ft. 2¾ in. long overall and arranged to make up a 6-ft. 1-in. bunk. Except for the location of the ceiling lights, which are placed on the center line of the upper deck ceiling and one in the transverse central plane of each pair of sections instead of in the planes separating the sections, as in the case of Pullman equipment, the arrangement of the sections does not differ materially in appearance from the standard Pullman car. Considerable departure is made, however, in both the men's and women's toilet facilities, and in the case of the women's lavatory, the extra length of the new cars has been used to increase the size of the room to a length of 6 ft. 9 in.

The photograph shows clearly the type of facilities with which the women's dressing room is fitted. These include three wash basins, each in a corner of the room and each of which is fitted with wing mirrors. Towels are kept in sanitary cases, standard on the Canadian National, which are placed at a convenient height so that the top of the case may be used to hold toilet articles. The doors on the front of these cases are hinged at the bottom and are held closed by spring hinges. Each dressing room is provided with three boudoir chairs.

It is the practice on the Canadian National to place the entrance to the men's toilet in the corridor instead of in the end of the smoking room. This makes it possible to place the three wash basins across this end of the room and thus to provide room for two chairs next to the car windows, in addition to the customary sofa across the inner end of the smoking room. The lavatory arrangement in the smoking



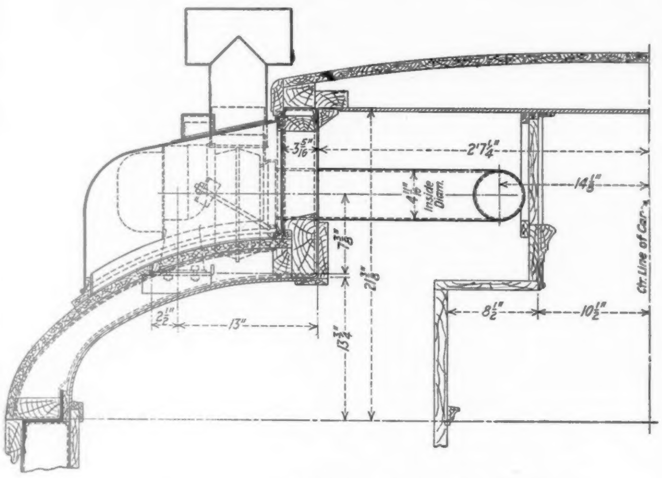
Floor Plan of the Canadian National Sleepers



Side Wall and Floor Details, Showing How the Car Is Insulated

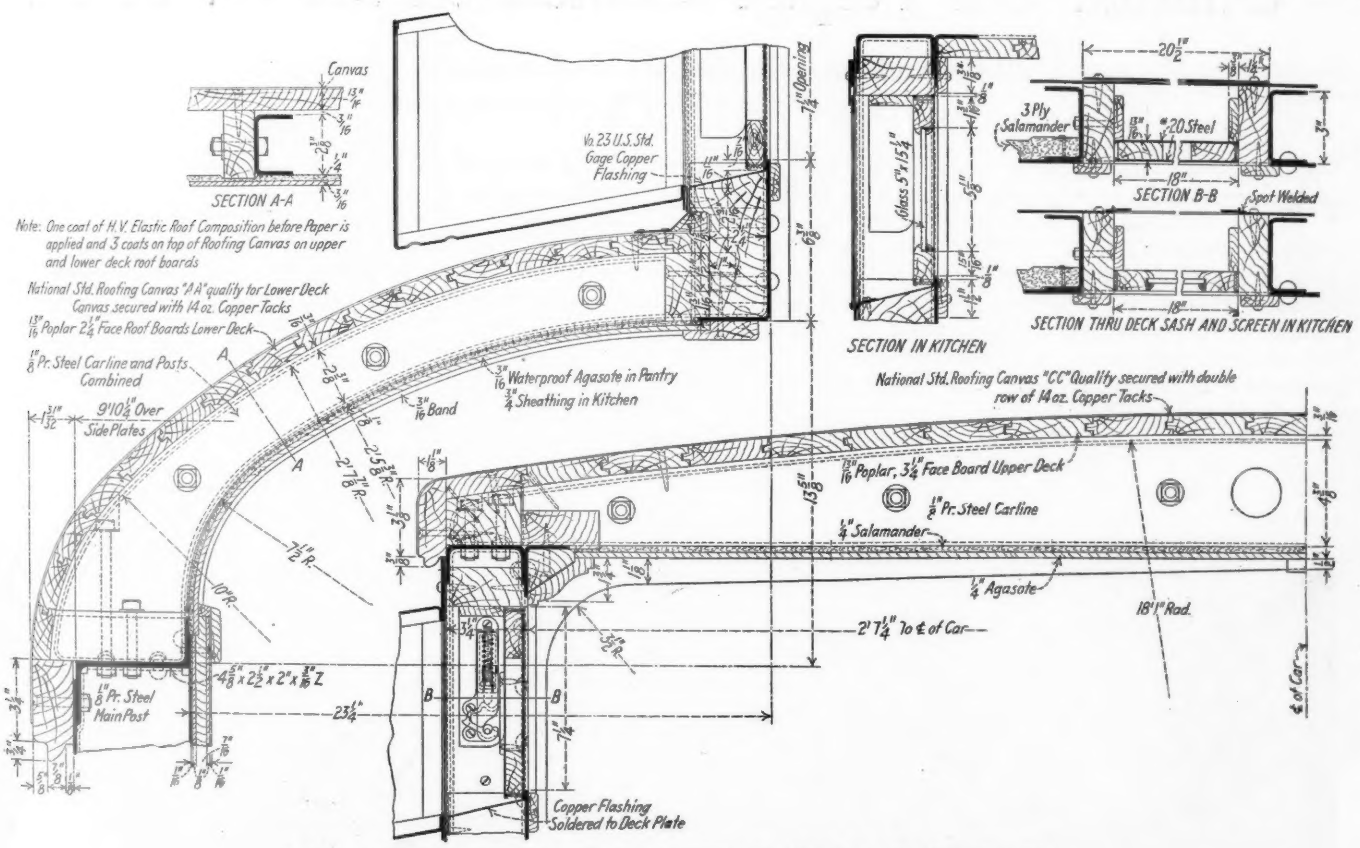
room consists of the three wash basins and two dental lavatories, back of which are three sanitary towel cases.

The principal improvement in the sleeping accommoda-



Location of the Power Ventilating Fan

tions as compared with older Canadian National sleeping cars is the adoption of separate curtains for the upper and lower berths. The upper berth curtains are arranged so that they may be fastened around a bar on the outer edge of the berth as a provision against the danger of falling out.



Details of Roof Construction Similar to Those Employed on the Sleeping Cars

General Construction

In the drawings are shown a number of the characteristic features of the construction of these cars. The drawing showing the roof details is that of a dining car, but applies also to the sleepers since the same type of construction is standard for all passenger equipment on the Canadian National.

The underframe is built up around fish-belly center sills, which are made of 5/16-in. web plate, with an outside top cord of 6-in. by 4-in. by 5/8-in. angle section with the short flange horizontal, and a top cover plate 1/2 in. thick by 30 in. wide. The bottom flanges of each sill are made up of inside and outside angles of 3-in. by 3-in. by 3/8-in. section. The deep section of the sills, which measures 2 ft. 6 in. over the flanges of the angles, is 29 ft. 1/2 in. in length. Through the bolsters each center plate is reinforced by a 14-in. by 3/8-in. plate, 8 ft. 1 5/8 in. long riveted on the inside and framed over the vertical flange of the bottom cord angle.

The side sills are built up of 5-in., 11.6-lb. Z-bars, with the top flange turned in, and a 2 1/2-in. by 3-in. by 1/4-in. angle riveted to the bottom flange, with the short leg flush with the inside of the steel sheathing.

The bolster is double, of the built-up type, with the two parts spaced 4 ft. 8 in. from center to center. Each part is made up of two 1/4-in. pressed steel plates, placed back to back with the flanges attached to the center and side sills, and with flanged steel fillers between the center sills. The bottom cord of each part is completed by a 1/4-in. cover plate, 6 in. wide at the ends and tapering to a width of 12 in. under the center sills. The entire bolster is finished with a 1/4-in. top cover plate extending from side sill to side sill, and 66 in. wide, longitudinally of the car.

The two crossbearers are 28 ft. apart. Each is made up of a single pressed steel web and center sill filler, flanged at the top and end and with a 5/16-in. top cover plate, 10 1/4 in. wide, extending across the car from side sill to side sill, and a bottom cord of 3-in. by 2 1/2-in. by 5/16 in. angle section, extending continuously across the car under the center sills.

The floor supports are 3/16-in. channel pressings, 5 in. deep. The entire space between the side and center sills is covered with 1/16-in. floor plate.

The vertical members of the side frame are of 1/8-in. U-section pressings, attached at the bottom to the side sill and at the top to a 4-in. by 3 3/16-in. by 3 1/16-in. by 1/4-in Z-bar side plate. The belt rail is a rolled section,

3 11/16 in. deep and 15/16 in. in thickness at the top, the lower portion of which is reduced to 7/16 in. The combined lower deck carlines and clerestory posts are ⅛-in. steel pressings, attached at the top to a ⅛-in. upper deck plate of inverted U-section. To this are attached the ⅛-in. channel section upper deck carlines. Wood carlines are bolted to the steel members as shown in the drawings, which also show in a general way the arrangement of wood members for the attachment of the inside wood finish. Particular attention was given to the insulation. The type and method of application are clearly shown in the drawings.

The cars are carried on Commonwealth six-wheel trucks with cast steel bolsters. The wheels are steel tired, 36 in. in diameter, with 5-in. by 9-in. journals. They are fitted with the American Steel Foundries clasp brake rigging, operated by Westinghouse LN equipment. Locking center pins are used to hold the car body and trucks together, in case of accident.

Heating and Ventilation

The cars are equipped with the Vapor heating system, thermostatic control, and two, three or five-pipe radiators. They are also equipped with a hot water heating system for use in case of emergency or should the cars be required to stand at isolated points where steam is not available. Two types of ventilators are included in this lot of cars. Half of them are of the Mudge-Peerless type and the other half the Utility honeycomb type. In addition to the automatic ventilators, each car is equipped with a 1/16-hp. Sturtevant exhaust fan operating at 1,750 r.p.m. The location of this fan is shown in one of the drawings. It exhausts air from the smoking room and also from the body of the car, at the smoking room end of the aisle, moving a total of approximately 500 cu. ft. of air per min.

The cars are equipped with the Stone-Franklin electric lighting system. The draft gear and buffing mechanism are Miner A-5-P friction type, and Miner B-10 type, respectively. Some of the more important dimensions and data are given in the table:

Weight	169,400 lb.
Length over end sills	75 ft. 6 in.
Length over buffers	84 ft. 4½ in.
Length between truck centers	57 ft. 6 in.
Width over side sills	9 ft. 9⅝ in.
Width overall at eaves	10 ft. 1⅞ in.
Width of clerestory	5 ft. 11¼ in.
Height, rail to center of roof	14 ft. 2 in.
Height, rail to sill at end	3 ft. 7⅝ in.
Height, rail to sill at center	3 ft. 9 in.

Unusual Car Repair Contest on the D. & H.

A $120 Prize Offered for the Best Performance in Rebuilding a Hopper Car; Five Teams Compete

A UNIQUE exhibition of car repairing was given in a contest held by employees of the Car Department of the Delaware & Hudson Company at its Colonie shops on October 31, 1923. The entire woodwork of five D. & H. composite twin hopper cars of 85,000 pounds capacity was removed and rebuilt in record time. These cars are equipped with steel underframes, metal posts and braces; the superstructures are of composite construction—wood and metal—wood predominating. The inner dimensions are: Length 32 ft., width 8 ft. 11 in. In a single car there are 1,947 board feet of lumber.

Five teams of six car repairers each participated in the contest, one team from Carbondale, Pa., representing the Pennsylvania division, one from Oneonta, N. Y., representing the Susquehanna division, and three from Green Island, representing the Saratoga division. At each of these points work of this character is an everyday performance.

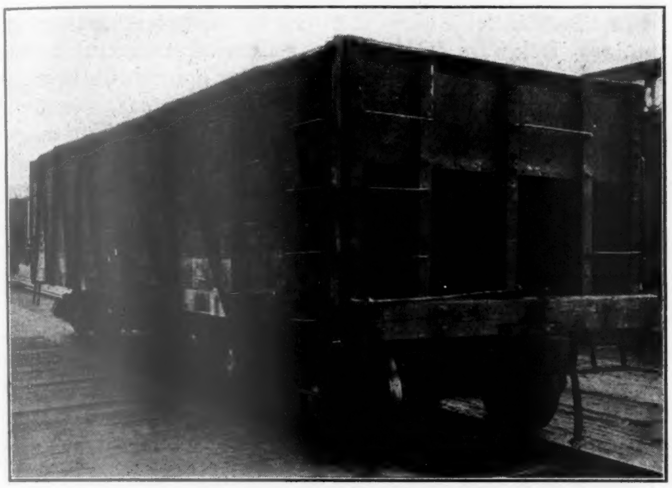
The response which greeted the announcement of the contest assured its successful results. However, stimulus, if any were needed, was provided by a prize of $120 in gold, offered by the management to the team proclaimed the winner upon the basis of workmanship and time. Interest ran high, the foremen were in frequent consultation discussing the probable candidates, and a friendly but spirited rivalry among the men ensued, each division endeavoring to select its best as a representative team.

This project was promoted to exemplify the merits of system and co-operation and the benefits accruing to the

The Winning Team—Left to Right: James Snee, Fred Ross, Larry Zappa, Tony Yaggort (Material Man), John Volano, Louis Moldinaro, C. W. Norris (Divisional Car Foreman), Leo Baker and Raymond Schuster (Foreman)

workmen under the piece-work plan of compensation. The performance indicates that it achieved its purpose.

The plans formulated for the occasion provided for the use of two sets of cars of identical type, the work to be strictly in accordance with standard shop practices. That none of the contestants should be afforded any advantage by



The Problem of the Contest—D. & H. Twin Hopper, Composite Car of 85,000 Lb. Capacity

reason of home shop conditions prevailing, Colonie, where heavy freight car repairs are made chiefly to box cars, was selected for the demonstration. Each gang worked under the direction of its foreman and the men were detailed to work where, in the opinion of the foreman, they could perform to the best advantage.

Operations started promptly at 8:00 a. m., proceeding

This Photograph Was Taken as the Dismantling Was Being Completed—The Carbondale Team Finished Its Car First, in 1 Hour and 37 Minutes

uninterrupted until completion, the men having voted to remain at work throughout the usual lunch period. Coffee and sandwiches were passed around and while this occasioned little delay, no allowance of time was made therefor in the record established.

Five cars in bad order were placed on one track for stripping, proper working space being provided. Likewise arranged on a parallel track were five other cars with the metal work already treated, preparatory to rebuilding, thus avoiding delay. First the tear-down work was undertaken and was completed in remarkably short time, notwithstanding the requirement that each piece of lumber removed should be freed of bolts, nuts and all other metal parts. The Carbondale crew completed the task first, doing so in 1 hour and 37 minutes, and within a very short time thereafter all teams had reported the work of dismantling ended. The maximum time was 1 hour and 57 minutes.

Promptly upon completion of the stripping the men pro-

THE STANDING OF THE FIVE TEAMS

	Time	Applied Man-Hr.
Carbondale Team		
Dismantling	8.00 a. m. to 9.37 a. m.	9 hr. 42 min.
Construction	9.37 a. m. to 3.49 p. m.	37 hr. 12 min.
Complete	8.00 a. m. to 3.49 p. m.	46 hr. 54 min.
Total time, 7 hr. 49 min.		
Green Island Team No. 1		
Dismantling	8.00 a. m. to 9.40 a. m.	10 hr. 0 min.
Construction	9.40 a. m. to 4.05 p. m.	38 hr. 30 min.
Complete	8.00 a. m. to 4.05 p. m.	48 hr. 30 min.
Total time, 8 hr. 5 min.		
Oneonta Team		
Dismantling	8.00 a. m. to 9.43 a. m.	10 hr. 18 min.
Construction	9.43 a. m. to 4.26 p. m.	40 hr. 18 min.
Complete	8.00 a. m. to 4.26 p. m.	50 hr. 36 min.
Total time, 8 hr. 26 min.		
Green Island Team No. 2		
Dismantling	8.00 a. m. to 9.50 a. m.	11 hr. 0 min.
Construction	9.50 a. m. to 5.05 p. m.	43 hr. 30 min.
Complete	8.00 a. m. to 5.05 p. m.	54 hr. 30 min.
Total time, 9 hr. 5 min.		
Green Island Team No. 3		
Dismantling	8.00 a. m. to 9.57 a. m.	11 hr. 42 min.
Construction	9.57 a. m. to 5.36 p. m.	45 hr. 54 min.
Complete	8.00 a. m. to 5.36 p. m.	57 hr. 36 min.
Total time, 9 hr. 36 min.		

ceeded to the opposite track where the work of construction was begun. Here it was found that all the material required had been systematically arranged, the lumber having been milled out to size and piled in the order of use at each car. Likewise, the necessary forgings and castings had been provided, together with the proper number of bolts. A material man was assigned to each gang, to render the customary assistance.

The material layout was one of the outstanding features, indicating, as it did, efficient and economical shop operation, and affording an ideal opportunity to study that phase of car repairing. The importance of the material feature cannot be overestimated. Its ready accessibility stimulates production and the resultant increased output is reflected in the earnings of the piece-worker.

The repairs made are scheduled as Class 4 with the exception of steel work. In so far as the woodwork is concerned, it constituted a rebuilt superstructure. Two men of each gang were assigned to the task of building and hanging

the hopper doors, after the sides and slopes were up. But in detail each gang attacked its job according to the methods prevailing at the shop represented, and each foreman had an opportunity to compare the effectiveness of his methods with those of the other gangs. One of the interesting features of the contest was the close comparison of the time in which the work was completed by the Carbondale team and the Green Island No. 1 team, although their procedures were different.

In each car 782 holes were bored with the aid of air motors, and in the fitting of wood parts 233 gains were made. A complete bill of material is shown in one of the tables.

The judges were A. A. Burkhard, general car foreman, New York Central Lines, D. H. Pyne, divisional car foreman, Boston & Maine and G. W. Ditmore, master car builder, Delaware & Hudson. Following a careful inspection, this committee reported that in its opinion the work of each team was of equally high standard so that the status of each was fixed by the order of completion, and Carbondale was declared the winner. In awarding the prize, Colonel J. T. Loree, vice-president and general manager of the Delaware & Hudson, an interested spectator throughout the performance, complimented the winners and expressed appreciation of the co-operation evidenced by the results. Thereupon, in behalf of the management, he made a further award of $50 to Green Island Team No. 1, which finished a close second.

As the records indicate, all the contestants made an excellent showing, reflecting credit on the system of training in vogue in the car department. The employees represent practically a new working organization, built up since July, 1922.

MATERIAL USED IN EACH CAR

Forgings and Castings

1	Brake wheel
1	Brake shaft
1	Brake pawl
1	Brake pawl ratchet
1	Brake pawl and ratchet bearing
2	Brake step braces
1	Brake shaft support
1	Brake chain
1	Brake cylinder lever fulcrum plate
2	Brake cylinder lever fulcrums
2	Uncoupling levers
2	Sta-Rite uncoupling lever attachments
4	Uncoupling lever brackets and fillers
2	End sill striking angles
4	End sill handholds
2	End sill washer plates
2	Coupler carrier irons
12	Body end stake clips
4	Body side channel stiffeners
4	Body diagonal tie rod level washers
4	Body corner angles
2	Wine side ladders
2	Wine end ladders
8	Body end and side handholds
2	Hopper slope supports, center
2	Hopper slope supports, bottom
2	Hopper slope supports, reinforcing plate
2	Hopper slope supports, casting
4	Hopper slope irons
16	Hopper slope hinges
16	Hopper door hinges
16	Hopper door washer straps
8	Hopper wye irons
4	Hopper door angles
8	Hopper door protection angles

Lumber

12	Side planks, Georgia Pine	716 b. ft.
10	End posts, Oak	106 b. ft.
2	Hopper supports, Oak	28 b. ft.
2	Slope supports, Oak	44 b. ft.
2	Side sill fillers, Georgia Pine	59 b. ft.
4	Center sills, Georgia Pine	19 b. ft.
	Hopper plank, Oak	129 b. ft.
	Slope plank, Oak	576 b. ft.
	Fulcrum block, Oak	4 b. ft.
	Door plank, Oak	111 b. ft.
2	End sills, Oak	135 b. ft.
1	Brake board, Oak	5 b. ft.
	Slope steps, Oak	12 b. ft.
	Fillers, etc., Oak	3 b. ft.

Machine Bolts

6	½ in. by 2½ in.
68	½ in. by 3 in.
12	½ in. by 4 in.
16	½ in. by 5½ in.
2	½ in. by 10½ in.
6	⅝ in. by 1½ in.
13	⅝ in. by 2 in.
46	⅝ in. by 3 in.
104	⅝ in. by 3½ in.
142	⅝ in. by 4 in.
17	⅝ in. by 4½ in.
24	⅝ in. by 5 in.
4	⅝ in. by 5½ in.
8	⅝ in. by 6 in.
4	⅝ in. by 6½ in.
2	⅝ in. by 7½ in.
26	¾ in. by 5½ in.
20	¾ in. by 6 in.
4	¾ in. by 7 in.
6	¾ in. by 9 in.
4	¾ in. by 10 in.
2	¾ in. by 13 in.
10	¾ in. by 14 in.
8	⅞ in. by 13 in.
4	⅞ in. by 15 in.

Carriage Bolts

198	½ in. by 2½ in.
56	½ in. by 3 in.
36	½ in. by 3½ in.
32	½ in. by 4 in.
32	½ in. by 4½ in.
6	½ in. by 5 in.
50	½ in. by 5½ in.
2	½ in. by 6½ in.

Miscellaneous

4	1¼ in. by 11 in. body diagonal tie
8	⅞ in. by 26 in. door hinge pins
1	1 in. by 9 ft. 5 in. center crosstie rod
2	½ in. by 3 in. lag screws
2	½ in. by 2 in. cotter keys
12	⅜ in. by 3 in. cotter keys
36	⅝ in. grip nuts
8	⅞ in. grip nuts
30	lb. wire nails
21	lb. ½, ⅝, ¾, ⅞ washers
782	holes bored
233	gains made

Steel Work Ready for the Application of the Wood, Which Is Systematically Laid Out for the Teams

LAST YEAR the 18 larger western railroads were earning a return of only 3.75 per cent on the value of their property held for and used in transportation service. A net operating income of $745,515,000 would be necessary if the railroads of this country earned the 5¼ per cent that is permitted under the Transportation Act. Notwithstanding increased traffic, they will fall short of this income by about $200,000,000. A compilation of the number of employees, hours worked and compensation for the year 1915 and the year 1922 showed an increase of 123 per cent in rate of wages of all employees in 1922 as compared with 1915. The total tax assessed against 23 leading railroads in 1910 was $60,401,109 and in 1922, the tax had increased to $191,822,953, or more than 217 per cent.

Journal Boxes with Anti-Friction Bearings

A Discussion of the Possible Standardization of Ball and Roller Bearings for Railway Cars

By Oscar R. Wikander

OSCAR R. WIKANDER, a Swedish-American engineer, has recently returned from Europe where he made a special study of the application of anti-friction bearings to railway car journals. While abroad, he represented the American Engineering Standards Committee at the First International Ball Bearing Conference held July, 1923, in Zurich, Switzerland. Mr. Wikander is a graduate of the Technical Academy, Chemnitz, Saxony, in Mechanical Engineering, and of the Technical University, Karlsruhe, Germany, in Electrical Engineering. He has had a broad engineering experience in the electrical, mechanical and aeronautical fields, in France, Sweden, Argentine and the United States. During his various activities in this country and abroad, he has been connected with railway work with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., and with the General Electric Company of Sweden in Stockholm. He is a member of the American Society of Mechanical Engineers, American Society of Swedish Engineers, Society of Automotive Engineers, Svenska Teknologforeningen, Stockholm, and chairman of the Sub-Committee on Information, of the Sectional Committee on Ball Bearings of the American Engineering Standards Committee.

IN view of the comparatively limited extent to which vehicles on rails have been equipped with anti-friction bearings, it may appear premature to discuss the question of standardization of journal boxes for such bearings at the present time. The available experience, however, indicates quite clearly certain lines which should be followed in the design of such boxes, in the interest of the railroads as well as of the bearing manufacturers. They may appear obvious, but the fact that they are not generally recognized and followed, makes it appropriate to state them.

Advantage of Standard Bearing Sizes

The proposed international standardization of ball bearings, which at the present time is being extended to cover all bearings sizes that might be considered for use in journal boxes, restricts the choice of bearings to a limited number of types and sizes.

To use bearings of special outside dimensions should be discouraged because the grading of standard bearings is fine enough to meet all practical requirements. The use of standard bearing sizes enables the railroad to substitute other makes for the one originally selected, if it should later appear desirable to do so. International standard size bearings are cheaper to buy and can be supplied from stock or on short notice from various manufacturers in different countries.

The proposed international ball bearing sizes are intended to apply to roller bearings as well and will be followed by many leading roller bearing manufacturers. For vehicles on rails it may be taken for granted that only precision roller bearings will be used to any appreciable extent, at least for all applications where the service is comparatively severe and considerable shock loads may occur. On account of their limited shock load capacity, ball bearings have not proved satisfactory for such service.

The Question of the Type of Bearing

A fundamental question in regard to the design of such boxes is whether one or more bearings should be used in each box. In early Swedish designs two self-alining ball bearings were used in each box, one of which carried radial as well as thrust load, while the other carried radial load only. This arrangement was used for freight and passenger cars, while two self-alining radial bearings and one thrust bearing were used for locomotive boxes to take care of the much higher thrust loads that are to be expected.

If journal boxes are equipped with self-alining ball or roller bearings, there is good reason to equip each box with two bearings, because one would not maintain the relative positions of box and axle. It is, however, possible to guide the box from the outside and at least one successful installation is in operation with only one self-alining roller bearing per box. If rigid roller bearings are used, one bearing per box is sufficient. If the wide series are used and this arrangement proves to be successful, it should be adopted wherever possible.

The Single Bearing Box

The following may be considered as the main advantages of the single bearing box as compared with the two or more bearing boxes. First, a solid box covered by one cap may be used. As a rule, two or more bearing boxes are required to be either horizontally split or to have two covers for each box in order to facilitate the mounting and removal of the bearings. Horizontally split boxes were eliminated from modern box construction years ago and railroad engineers are, for very good reasons, strongly opposed to such boxes. Second, one bearing is easier to install, inspect and remove than two or more bearing boxes. Third, the bending moment, caused by the load on the journal box and acting on the axle section at the shoulder of the inside bearing, is smaller in case of the single bearing, on account of the smaller leverage. Consequently it is possible to use a smaller bore for the single bearing than for the inside bearing in a box with two or more bearings. The outside diameter of the single bearing can, in most cases, be made smaller than the outside diameter of the inside bearing in a two-bearing box of the same load carrying capacity. Fourth, the single bearing box is, therefore, smaller, lighter and cheaper than the corresponding box with two or more bearings and is easier to adapt to existing car truck designs.

The load conditions of a railway journal box are such that

they are easily met by one bearing of proper design. They are entirely different from those in the front hub of an automobile, for instance, where the arrangement of two bearings is preferable.

Loading Conditions of a Journal Box

In the case of vehicles running on rails, the wheels are rigidly mounted on the axle, while automobile front wheels turn on a stationary axle. Referring to Fig. 1, a force K_1 acting on the rim of an automobile wheel in the direction of the axle, is effectively taken up by the two forces K_1 and K_2 reacting through the two roller bearings in the hub.

The corresponding thrust force K, which is similar in the case of vehicles on rails, is comparatively small and does not exert any turning moment on the journal box bearing, because the wheels are firmly mounted on the axle as shown in Fig. 2. Such turning moments as may be exerted on the journal box by thrust forces transmitted to the box through the spring or the pedestals, are so small that they can easily be taken up by any roller bearing of the rigid type. The load conditions, therefore, do not justify the arrangement of two or more bearings per box.

Relation of Load and Bearing

The next question to decide is how to place the single bearing in relation to the load acting on the journal box. In order to avoid producing a turning moment which this load would ordinarily do in a longitudinal plane of the bearing, it is of course advisable to place the bearing directly under this force so that the weight of the load passes through the transverse central plane of the bearing.

Selecting the Proper Type of Bearing

Most railroads prescribe a certain maximum bending stress in the axle caused by the static load, and on this basis it is possible to ascertain the maximum load which may be permitted to act in the transverse central plane of any standard roller bearing.

In selecting the proper bearing type, preference will as a rule be given to the wide type of the heavy series, due to the fact that these bearings have the largest load carrying capacity for a given outside diameter or the smallest outside diameter for a given carrying capacity. A small outside diameter is desirable because the space between the center of the axle and the top of the journal box is often limited.

The dimensions of the roller bearings of the wide heavy series are given in Table I. The values given correspond to the latest proposals for international standards for such bearings. Assuming that the maximum permissible bending stress which may occur in the axle end is known, it is then possible to calculate the maximum static load for which each bearing of the above series may be used without exceeding the maximum permissible bending stress. If we let:

Q = the maximum static load on the bearing in pounds, within the limits of the permissible bending stress in the axle.
C = the distance of the bearing center from the axle shoulder against which the bearing is held, or from the section of the axle in which the greatest bending stresses occur.
K_b = the maximum permissible bending stress in lb. per sq. in. prescribed by the railroad for the service in question.
d = the bore of the bearing in inches.

$$A = \text{a constant} = \frac{0.1d^3}{C}$$

Then we can derive the equation

$$Q \times C = 0.1d^3K_b \text{ or } P = AK_b$$

The constant A is different for each bearing bore and depends also upon the distance C. This is composed of half the width of the bearing and sometimes of an additional distance which differs according to the arrangement of the bearing on the shaft.

The following calculations apply to a concrete case: namely, the usual type of a Jaeger roller bearing journal box, as represented in Fig. 3. In this design a disk S is inserted between the roller bearing and the shaft shoulder, which disk occupies a space in the direction of the axle of about 10 mm. It is provided with a large fillet and, therefore, it is very conservative if we assume that

$$C = \tfrac{1}{2} \text{ the width of the bearing } + 10 \text{ mm.}$$

On this basis we have calculated the values of C in Table I. The corresponding maximum values of Q are obtained by multiplying these values by the maximum static bending stress in the axle permitted by the competent authority. The table also contains the catalogue loads of the wide Jaeger roller bearings of the heavy series for 200 and 500 r.p.m.

The following example will illustrate the use of Table I: The new, large freight cars of the German state railways are partly equipped with Jaeger roller bearings of 100 mm. bore, which is equal to 3.9370 in. . The maximum static load per box is 10,000 kg., or 22,000 lb. The maximum permissible bending stress in the axle is 700 kg. per sq. cm., or about 10,000 lb. per sq. in. The maximum speed is 60 km. per hour, or about 37.5 m.p.h. The distance $C = 49 + 10 = 59$ mm., or 2.3229 in., and consequently

$$A = \frac{0.1d^3}{C} = 0.1 \times \frac{3.9370^3}{2.3229} = 2.64$$

We thus find, according to the preceding formula, that

$$Q = AK_b = 2.64 \times 10{,}000 = 26{,}400$$

The bearing load should thus, in view of the maximum permissible bending stress in the axle, not exceed 26,400 lb. As the maximum load only amounts to 10,000 kg., or 22,000 lb., the axle is amply strong. It is thus in every case easy to ascertain whether a bearing from this point of view is suitable for a certain application.

Ratings of Anti-Friction Bearings

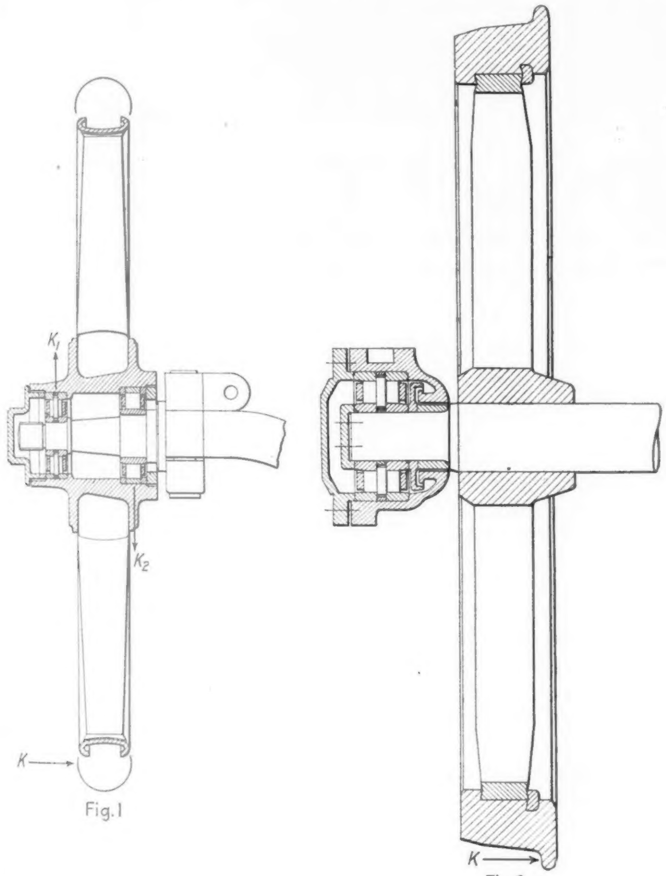
The maximum bearing load must furthermore be smaller than the load carrying capacity of the bearing at the maxi-

TABLE I

Bearing number	Bored		Outside dia.		Width W		Radius T_1	Distance C		Catalogue load in thousands of lb. at		Constant A	
	Mm.	Inches	Mm.	Inches	Mm.	Inches	Mm.	Mm.	Inches	200 r.p.m.	500 r.p.m.	In sq. cm.	In sq. in.
3,410	50	1.9685	130	5.1181	53	2.0866	1.0	36.5	1.4371	8.4	7.1	3.4	.527
3,411	55	2.1654	140	5.5118	57	2.2441	1.5	38.5	1.5158	9.3	7.9	4.3	.667
3,412	60	2.3622	150	5.9055	60	2.3622	1.5	40	1.5748	10.5	8.9	5.4	.838
3,413	65	2.5591	160	6,2992	64	2.5197	1.5	42	1.6535	11.5	9.8	6.5	1.01
3,414	70	2.7559	180	7.0866	74	2.9134	1.5	47	1.8504	14.7	12.5	7.3	1.14
3,415	75	2.9528	190	7.4803	77	3.0315	1.5	48.5	1.9095	15.8	13.6	8.7	1.35
3,416	80	3.1496	200	7.8740	80	3.1496	2.0	50	1.9685	17.5	14.8	10.3	1.60
3,417	85	3.3465	210	8.2677	86	3.3858	2.0	53	2.0866	18.3	15.6	11.6	1.80
3,418	90	3.5433	225	8.8583	90	3.5433	2.0	55	2.1654	22.3	18.7	13.3	2.064
3,419	95	3.7402	240	9.4488	95	3.7402	2.0	57.5	2.2638	25.8	21.7	14.9	2.314
3,420	100	3.9370	250	9.8425	98	3.8583	2.0	59	2.3229	30.5	25.8	17.0	2.64
3,421	105	4.1339	260	10.2362	100	3.9370	2.0	60	2.3622	35.3	29.9	19.2	2.98
3,422	110	4.3307	280	11.0236	108	4.2520	2.0	64	2.5197	41.0	34.6	20.3	3.15
3,424	120	4.7244	310	12.2047	118	4.6457	2.0	69	2.7166	46.7	38.2	25	3.88
3,426	130	5.1187	340	13.3858	128	5.0394	2.5	74	2.9134	52.9	43.7	29.7	4.61
3,428	140	5.5118	360	14.1732	132	5.1968	2.5	76	2.9922	58.6	49.2	36.2	5.62
3,430	150	5.9055	380	14.9606	138	5.4331	2.5	79	3.1103	64.8	53.4	42.8	6.65
3,432	160	6.2992	400	15.7480	142	5.5905	2.5	81	3.1890	70.3	58.2	50.7	7.87
3,434	170	6.6929	420	16.5354	145	5.7087	3.0	82.5	3.2480	75.6	63.3	59.7	9.27
3,436	180	7.0866	440	17.3228	150	5.9055	3.0	85	3.3465	80.7	68.8	68.7	10.67
3,438	190	7.4803	460	18.1102	155	6.1024	3.0	87.5	3.4449	85.1	....	78.3	12.15

mum speed at which it has to operate. In order to obtain this load carrying capacity, the catalogue load of the bearing has to be divided by a certain safety factor.

Unfortunately, the catalogue loads of the various anti-friction bearing manufacturers are established on an entirely different basis and can, therefore, not be compared. At times, the ratings of equivalent bearings differ as much as



Contrast Between Automobile and Railway Car Journal Bearing Conditions

100 per cent in the catalogues of different manufacturers.

In case of the Jaeger roller bearings, which have a very conservative rating, it is sufficient to use a factor of safety of 1.3 for journal box bearings, while other bearings, which have about double the catalogue rating, require a factor of safety of 2.6 or more.

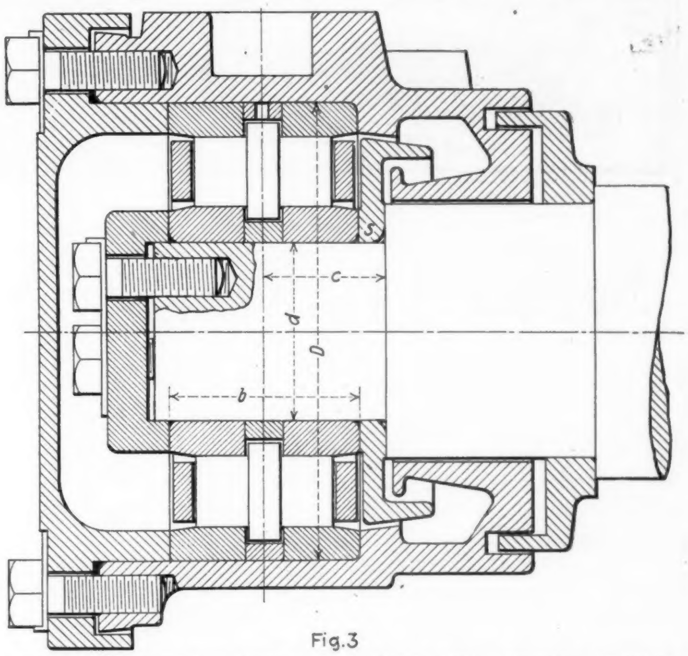
In the case under consideration we find that the maximum speed of the axle is 300 r.p.m., for which speed a catalogue load of 13,000 kg. or 28,600 lb., can be computed. For the existing maximum load of 10,000 kg., the corresponding factor of safety is thus 1.3, which is sufficient.

Suggested Basis for Standardization

On the basis of the above considerations, the writer suggests that all designs of railroad journal boxes, to be equipped with anti-friction bearings, be standardized as to the following points: First, bearing sizes should be specified according to the proposed or accepted international standards for ball bearings. Second, each journal box should be a solid steel casting, simply closed by a front cover. Third, the box should contain only one roller bearing and the center line of the load on the journal box should pass through the center of the bearing.

Table I contains in addition to the main dimensions of the standard wide heavy series, also the maximum radii of the shaft shoulder and bearing housing fillets, T_1, which may be used in connection with these bearings.

For the convenience of the users, we give in Table II the



Sectional View of Car Journal With Single Roller Bearing, Showing Dimensions for Which Standardization is Proposed

internationally proposed bearing tolerances as well as the axle and housing tolerances, which should be specified.

The German state railways are at the present time preparing or making extensive tests with a number of different anti-friction journal box designs furnished by the various prominent German ball or roller bearing manufacturers, and it is interesting to note that the designs of Jaeger, Krupp, Riebe-Werke, Fichtel & Sachs, follow the above suggested lines of box design, using one centrally located bearing in each box, while two equally prominent manufacturers use two or more bearings per box.

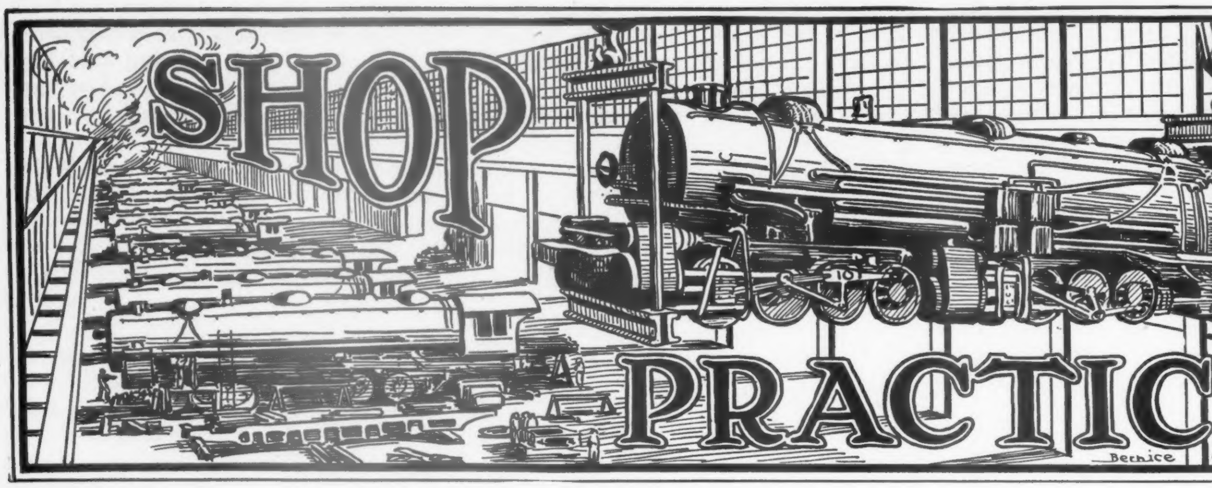
Summary

The author suggests as a basis upon which to standardize journal boxes with anti-friction bearings for vehicles on rails the following for consideration: First, bearings of the proposed international standard sizes should be selected. Second, each journal box should consist of one solid housing closed by a front cover. Third, the box should contain only one bearing and the center line of the load should lay in the transverse central plane of the bearing.

This information will enable the designer to calculate the space needed to apply anti-friction bearings to any truck.

TABLE II

Range of diameters	Corresponding tolerance limits for bearing bore and outside diameter Minimum = O Minimum		Shaft diameter Maximum		Shaft diameter Minimum		Housing bore Maximum		Housing bore Minimum	
	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.
Above 30-50	.012	.0005	.003	.0001	.021	.0008	....	.....	....	.....
Above 50-80	.015	.0006	.005	.0002	.025	.001	....	.....	....	.....
Above 80-120	.020	.0008	.009	.0004	.031	.0012	....	.....	....	.....
Above 120-180	.025	.0010	.012	.0005	.038	.0015	.040	.0016	.013	.0005
Above 180-260	.030	.0012	.015	.0006	.045	.0018	.045	.0018	.015	.0006
Above 260-360	.035	.0014	....	.....	....	.....	.060	.0024	.018	.0007
Above 360-500	.045	.0018	....	.....	....	.....	.070	0028	.020	.0008



Surface Hardening with Oxy-Acetylene Flame

The Torch Process Will Mark Out for Itself a Field Sharply Defined and Superior to Its Competitors

By J. F. Springer

EXPERIMENTS reported in the early part of the present century showed that iron could be impregnated with carbon by heating it in a slow current of carbon monoxide (CO). The temperature was varied from 1,040 deg. to 2,174 deg. F. At the lower temperatures, the period of heat covered eight hours. Some carbon was left as a powdery deposit on the iron surface, and so did not impregnate the metal. From 1,382 deg. up, however, no carbon deposits were formed. It has been assumed that this means that pure iron exposed to CO at such high temperatures must absorb all the carbon actually set free. The investigator checked the amount of carbon absorbed in three different ways. The increase in the weight of the iron constituted one. Second, the residue of the carbon left in the gas was determinable by ascertaining the weight of CO_2 produced from the CO by the abstraction of carbon. Finally, by heating the impregnated metal, in a current of oxygen, the quantity of carbon absorbed could be ascertained.

From the agreement of the three sets of figures, it was possible to get information as to the amount of carbon actually absorbed by the iron at various temperatures. The range from 1,517 deg. to 1,877 deg., proved a most excellent one. It was found to be possible to carbonize iron and presumably soft steel as well, by means of a slowly moving atmosphere of carbon monoxide, provided a moderately high temperature was used.

The flame used in the oxy-acetylene welding and cutting processes supplies a high temperature and also supplies the carbon monoxide. It seems that the correct explanation of what occurs in the flame is that the one volume of acetylene and the one-and-a-fraction volume of oxygen, which emerge together from the heating tip, do not at once undergo a reaction. First, the acetylene decomposes in an explosive manner into carbon and hydrogen. That is, the C_2H_2 breaks up into its constituent gases. All three elements, C, H and O, flow along together for a short space, the carbon producing the whiteness of the little inner flame characteristic of the oxy-acetylene torch. At the outer terminal of this short, white pencil of flame the carbon and oxygen unite and form CO. There is a certain amount of oxygen which varies with different makes of torches, that is supplied in excess of what is actually requisite for the production of CO. This excess, together with oxygen from the surrounding air, is understood to unite with more or less of the CO and with the H to form CO_2 and H_2O. These unions are accomplished in the big enveloping flame which belongs to the oxy-acetylene torch when in action.

From this it has been surmised that the oxy-acetylene torch might perhaps supply CO under conditions of proper temperature to impregnate the surface of an iron or a steel object with carbon. It thus effects a true carbonization of the exterior film of the metal. Naturally, this carbonized film may be heated and quenched with the result that the highly carbonized skin is made very hard, just as is the case when iron and steel objects have been case-hardened in the usual way.

Three Oxy-Acetylene Torch Adjustments

There are in fact three distinct adjustments that may be made on the oxy-acetylene torch. First, there is the normal adjustment when the little white flame is single and sharply defined. With this, the action is more or less neutral, the metal being neither oxidized nor carbonized. Then there is the case where more oxygen is supplied than is required, and this flame acts as an oxidizer. Finally, when less oxygen is supplied than is required for the normal adjustment, we get an excess of acetylene. This means free carbon to a greater or lesser extent. It is the type of flame where an excess of acetylene is supplied that is of particular value in the surface hardening of iron and steel with the oxy-acetylene torch.

A second method of carbonizing is by excluding the oxygen supply that ordinarily goes to the mixing chamber of the torch and there mixes with the acetylene preparatory to the emergence of the mixture from the tip. This amounts to converting the torch into a mere acetylene burner deprived of bunsen-burner openings. A certain amount of success has been attained with this type of flame when used for carbonization purposes. The acetylene flame in contact with the metal surface has produced in two minutes a carbonized film 0.008 in. thick. It is said that the result is similar to that produced by the use of a hardening powder.

If such an acetylene flame is properly applied to the surface of two per cent nickel steel, a two-minute period will be sufficient to effect a penetration of the carbon to a depth of 0.012 in. In the case of a cast-steel object, one may secure with the simple, acetylene flame a carbonized film 0.016 in. thick in the course of 5 minutes. The film will be similar to that produced by a prolonged application of the usual case-hardening process.

Use of the Carbonizing Flame

It is in the adjustment of the torch whereby an excess of acetylene is obtained that we are going to get superior results. A considerable range may be included in this type of adjustment, and this means a range of carbonizing intensity. The normal adjustment of the torch may be made with great precision, simply by using the inner white flame as a guide. When this flame is sharply defined and when it is also single in form, then and then only is the adjustment to be considered normal. From normal adjustment, the deficiency in oxygen may be carried on down until we arrive at the point where no oxygen is supplied to the mixing chamber.

It is to be noted particularly that by a selection of torches and also of the amount of acetylene excess, we may provide for a large range of carbonizing activity. We may vary the velocity of the stream of gas, and we may also vary the excess acetylene in this stream. The work will naturally vary, because it will be desirable to carbonize iron, soft metal and steels of higher contents of carbon. We will also have to handle alloys of various kinds. Carbonization processes are required in great variety because of the services in contemplation and also because of the variations in the metal to be treated.

Limitations of Oxy-Acetylene Carbonizing

There are certain limitations to the process. If a very slow carbonization is necessary in order to produce a given regularity of impregnation, then the oxy-acetylene torch may fail to be a suitable and practical means. It is also probable that the torch method may not be suitable where great regularity, not in degrees of impregnation as the depth increases, but in respect to the area treated, is desired. If the work requires that the impregnation shall be exactly the same all over the surface, then the torch is not to be employed. The torch method should be given careful consideration before it is used, where great exactness is required in any way or form. There are undoubtedly many varieties of case-hardening wanted that the torch can not well supply.

However, there are considerations of convenience, quickness of result, and the like that are on the side of the torch. It is not to be expected that torch-hardening will eventually supplant the older methods altogether, but that it will mark out for itself a field more or less sharply defined and that in this field it will be superior to its competitors.

Main Advantages of the Torch Process

It would appear that the torch method is in competition with those processes which employ powders sprinkled or spread as a paste over the surface. The torch method is to be considered in cases where a very thin carbonized film is satisfactory, and where this film is not required to be uniformly impregnated. Ease and quickness of application are its main advantages. If the requirements as to quality are not too severe, the user of the torch process may find himself greatly benefited.

The carbonizing flame of the oxy-acetylene torch can be made to effect rapid carbonization of the metallic surface. One of the first rules of procedure is to avoid getting the little white pencil-like flame in actual contact with the surface of the metal. If this should happen, we can expect the immediate formation of a superficial alloy of soft iron. In treating Siemens-Martin steel, if the end of the brilliant white pencil of flame is kept 0.6 in. from the metal surface, we may expect to produce a very regular film of carbonized steel containing more than 0.90 per cent of carbon. The major part of the film will consist of tool steel capable of being instantly hardened to a high degree in the usual manner.

By employing the same torch for a period of one minute in treating the surface of a steel casting under the same circumstances, there can be produced a carbonized film 0.012 in. thick. The thin layer is said to be extraordinarily hard and to be similar to that which results when one employs the yellow prussiate of potash.

If the period of application of the oxy-acetylene torch is to be considerably prolonged, it will be necessary to work with a still greater interval between the outer end of the white flame and the surface of the metal. A distance of about 1¼ in. may be necessary. If the proper interval is continually maintained, then we may expect a regular and deep film of high carbon steel.

Apparently there flows from the outer end of the white pencil a stream of uncertain length consisting largely of CO. At some point in this stream, there will be a condition suitable to the metal in hand and the carbonization result desired. The difficulty is to find it. Once found, it is valuable information for future reference.

Experiments on Cast Steel

For purposes of experiment, cast steel was treated for a period of 10 min. with the carbonizing flame, which produced a film 0.12 in. thick. It consisted of steel which nowhere had a higher carbon content than 0.85 per cent. This is just about the dividing point between tool steels and those of a softer character. This metal, when in normal condition, consists of pearlite. The grains of pearlite are not contained in a honeycomb of ferrite nor are they contained in a honeycomb of cementite. Such steel can be hardened by heating and quenching, but it will not harden to the same extent as steel the pearlite grains of which are in a honeycomb of hard cementite.

It is to be remembered that in the natural, unhardened condition, the hardness of steel corresponds pretty well with the content of the hard cementite. Ferrite is soft, as may be seen by testing with a file an ordinary wrought-iron horseshoe nail. Cementite is exceedingly hard, which may be demonstrated by testing a piece of white iron in the same manner. Pearlite consists of alternating layers of these two materials and has an intermediate hardness. Further, the artificial hardness produced by quenching heated steel is roughly in proportion to the natural hardness which it replaces.

Conclusion

With these things in mind, the reader will be fairly well prepared for the following results obtained when the steel surface was exposed to the oxy-acetylene flame at too short a distance from the white pencil. A film having a thickness of 0.08 in. was produced, consisting near the surface of an excessive amount of cementite. Too much hardness was obtained. Even after several attempts at annealing, it was impossible to saw through the materials.

It would seem, that in any particular case, the interval between the outer end of the white pencil and the surface of the work is a matter of prime importance. When the interval is cut down carbon monoxide is supplied in a rather heavy amount. Either the distance should be increased or else the period of operation should be reduced.

An application of the torch for two minutes may suffice to produce a hardness equal to that obtainable with the most energetic of hardening powders. If the period is prolonged to 5 or 10 min., we may secure a carbonization having a depth of 0.08 to 0.12 in. under proper conditions. The carbonization is then very regular and it never attains a carbon content of such a degree that cracking will occur during the quenching.

Spreader for Locomotive Welding

By L. M. O'Kelley
Seaboard Air Line, Tampa, Fla.

THE illustration shows part of a main section that was welded into a locomotive frame on engine No. 647 of the Seaboard Air Line. This is a very common weld for this class of engine, but the method of getting the expansion is somewhat different than that commonly used. As a result of an experience of 15 years in making thermit welds, it is believed that 90 per cent of the defective thermit welds are due to improper expansion. This shop has used jacks, wedges and other devices to get the proper expansion, but nothing, except the spreaders here described, has been found that would not give way to some extent under the high strains. This method was first put in use about two years ago.

Spreader Being Used While Welding Main Section of Frame

The frame, as shown in the illustration, has a goose-neck curve between the main and back pedestals at the point where it passes under the firebox. The weld made just under the corner of the firebox was in repair of a break common to this class of engines.

The spreader consists of an old main rod cut off to fit between the back and main pedestal. On the end of the rod is a 26-in. key made of tire steel, which is driven into the key slot. The rod is placed in the frame as shown and is then wedged in tightly by driving in the key. This device is guaranteed to hold after once set in place with an ordinary 12-lb. sledge hammer. This same type of spreader is also used in getting the expansion in a break between the pedestals. Unlike a jack, it will not give way or yield during the welding operation.

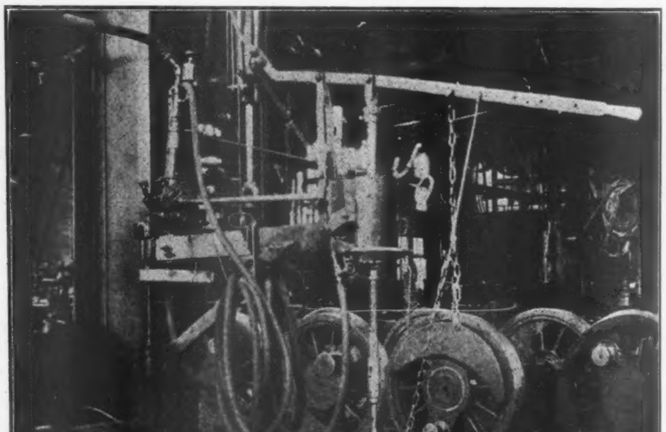
Suggestions for Wheeling Locomotives

By A. S. Duryea
Shop Foreman, Oregon-Washington R.R. & Navigation Co., La Grande, Oregon

TRY to have one locomotive to wheel and one to unwheel, or two to unwheel and one to wheel, as this saves the time it takes to get the equalizer out of the pit and put it back again for each engine.

Always hold the weight of the engine with the crane until the wedges and binders are up and one nut on each end of the binder, then the wheels may be lifted clear of the track and the pins spotted for the rods. This is a quicker and better way of spotting the pins than with the old slipping bar.

When it comes to putting up binders on heavy power, holding the weight of the engine is a big saving as the boxes and saddles will not cock. This makes it possible to straighten them readily which is not easily accomplished with the weight on them.



This Home-Made Drill Press Driven by an Air Motor Saves a Lot of Trucking and Waiting

Formerly we used wooden wedges to hold the boxes straight but sometimes had trouble with them sticking and had to chisel out a few, so we tried the plan as mentioned above. There seems to be no reason why shops of all sizes could not adopt the same method with advantage.

In wheeling a locomotive we use three machinists and their helpers, with two handymen and their helpers and it takes us on an average one hour and forty minutes to have the binders and wedges set up and the engine trammed out. We have done it in an hour and twelve minutes.

We have rigged up a convenient drill press out of an old air motor which fastens onto the rod bushing press, being carried on a swinging arm having a 4 ft. radius. The bushing press holds or clamps the rod while it is being drilled for the oil and the keeper bolt holes. The driving boxes are also drilled on this press and its usefulness is further increased by the addition of a low speed attachment for reaming rod bolt holes. This little machine has accomplished a considerable saving in time as it does away with the trucking of the rods from the drill press to the rod bench and back again.

Suggestions for Improving Shop Management

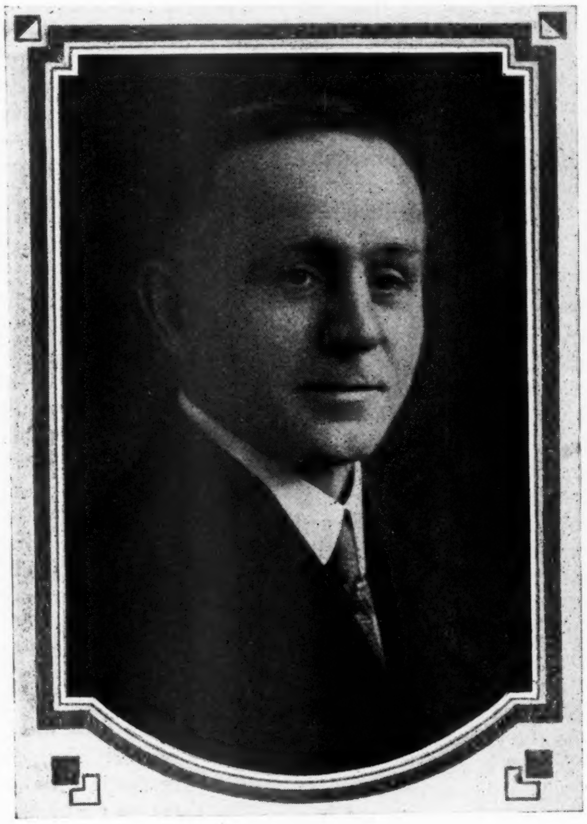
Methods Are, of Course, Important, But in the Last Analysis It is the Spirit That Counts

First Prize*

By Frank J. Borer
Freight Shop Foreman, Central Railroad of New Jersey, Elizabethport, N. J.

THE problem of the best and most efficient form of shop management has many angles. It is a great deal like advising one as to the best road to heaven. There are many approaches, but there seems to be only one main entrance. To my mind, so far as shop management is concerned, this consists of successful dealing with human nature. This implies consideration, confidence, co-operation, good working conditions and adequate pay according to service rendered, on the one hand, and loyalty and enthusiam on the other.

Successful shop management is not the job of the shop superintendent, works manager, or general foreman alone, but rather the job of every officer and employee concerned with or employed at the shop. Everyone must have a common interest to render service and to contribute his full share to the sum total of the efficiency of the entire plant. To secure this, it is of vital importance that friction and misunderstandings between departments and between the management and the employees be eliminated, or at least reduced to the lowest possible point, and an atmosphere of co-operation, love for service and an incentive to give value for value received be maintained.



Frank J. Borer

The right attitude of the employee towards the job entails a campaign of education and the elimination of harmful outside influences. He must believe in, and have confidence in those in authority. He must be satisfied with his job so far as this is possible in the light of human aspirations.

The Foreman and His Responsibility

The chief burden of the work of educating the employee along these lines falls upon the supervisor, foreman or assistant foreman. He is the "contact man" between the management and the employee. He is the most important link in the chain of successful shop management. To the extent that he is educated in the proper performance of his duties, that he is able to interpret the policy of the company and to use diplomacy in dealing with employees, that he is resourceful, able and impartial, or, on the other hand, that he is hampered by lack of proper education, by petty jealousy, envy, or lacks good judgment or a co-operative spirit towards other departments and his superiors; just to that extent will shop management be successful or not. However, nobody is all good or all bad. Therefore, the thing to strive for is to add to the good qualities and eliminate the bad ones of the members of the supervisory force.

It is quite natural that the morale of the average employee will not and cannot be any higher than that of his immediate superior. He will be inclined to interpret the attitude of the management according to that of his gang foreman or supervisor. It therefore follows that the supervisory force of all departments of the plant should be educated, instructed and guided to see that the state of mind of each one of them is a reflection of that of the higher officers; in this manner the proper spirit will be developed among the employees and the seed of efficiency is bound to grow.

Clear Away Weeds of Misunderstanding

Having cleared away the weeds of misunderstanding, ill-will, jealousy, carelessness, irresponsibility, ignorance and the like, and put in their place good-will, confidence and co-operation, the real work has then just begun, because in problems interwoven with human nature, such as successful shop management, it is like clearing a large field or forest of weeds and underbrush. Both will always grow up again. But the successful forester will hold both of them down to a point where they will not interfere with the growth of the plants or trees.

Foremen's Clubs

In line with this thought, weekly meetings of the supervisory forces are a necessity. They act as a clearing house between sub-department chiefs and gang foremen. They give every supervisor an opportunity to voice his view in regard to any lost motion that may exist in his or other departments and to develop ways and means of overcoming it. Such items as shortage of material supply, new materials received, machinery and tools, shop and safety rules, accidents and how to avoid them, new methods of doing work and shop kinks, reclaiming and storing material, fire hazards and how to thresh out grievances and the best methods of increasing production, should be considered at these meetings. Such

*Mr. Borer's article was awarded the first prize in the Shop Management Competition, which closed September 15, 1923. For other awards see *Railway Mechanical Engineer*, December, 1923, page 794.

conferences put the spotlight on the man who does not come up to the standard and impels him to do better.

This is not enough, however. Lecture courses and occasional meetings with the higher officers should augment them. The Pennsylvania Railroad has gone a long way in this direction, as was so ably explained by I. U. Kershner at the May, 1923, meeting of the New York Railroad Club.* If we want loyal and efficient employees, we must first have a supervisory force imbued with loyalty; therefore the necessity of extending as far as possible the educational features and contact with the management.

As a further means of strengthening co-operation between the management and the employees (which in turn will result in increased and better production) I would suggest that the board of directors, if feasible, set aside new issues of stock to be sold to employees at par on monthly payments, similar to the plan that is now so successfully carried out by the Standard Oil Company. Looking at this plan from the spirit of the saying, "Where thy treasuries are, there is thy heart," much good should come from it. "It is not so much what you produce per hour or per day as it is of how much you can save in producing it" is the way a prominent railroad official recently summed up the problem of increased production.

Causes of Labor Unrest

High wages never did and never will in themselves make men loyal and contented—never will solve the labor problem, although it is understood that reasonable, just wages, according to service, are a means to the end. Labor unrest is not the result of low wages and poor working conditions, or else the American workingman, being the best paid and also the most efficient in the world, would not go on strike. Labor unrest, as it enters into railroad shop management, is for the most part caused by outside agitators. The railroad shop crafts can do much to counteract the bad outside influences and should be afforded every means to work in full accord, through its committees, with the shop management. Employees should have an opportunity to present their grievances to the committeeman and these must be settled impartially.

In applying discipline to employees, care must be exercised to see that they get their just dues on the one hand, and that the efficiency of the forces is not lowered through lack of respect of shop rules or supervisors. In this respect, the system of discipline most in use in railroad shops is too unwieldy. It is either discharge or nothing. Be considerate in the handling and treatment of men. Don't be a quitter. Do not lack in courage but at the same time put yourself in the other fellow's shoes for a moment.

Suggestions for new shop kinks and about improved methods of doing work should be encouraged from employees and supervisors and tried out. If found practical, proper credit should be given these men.

The morale of the force can be raised by affording the men opportunities for self-improvement, recreation, railroad athletic associations and the like; further, by the foremen showing sympathy and interest in the workmen's problems and teaching the less educated the duties of citizenship.

There are always sinister forces at work, especially among the uneducated workingmen, to make them discontented and suspicious, to make them believe they are being robbed, exploited, abused and "bulldozed" by their employers. Little grievances are magnified, are looked at through the microscope. No wonder they look large to them. These bad influences must be counteracted and neutralized. It is not hard, for the truth will prevail in the end. But things do not change of themselves. The shop management must therefore give these things proper attention.

*See Railway Age, May 26, 1923, page 1259.

Reducing the Turnover

The turnover of the employees in normal times is another problem of shop management. To keep good employees in the service and to eliminate those that are falling below a reasonable standard of efficiency is a task of first importance, and there again we have to depend in a large measure upon the gang foremen. A large turnover means a large waste. It can be minimized and production increased at the same time by good working conditions; placing men on work for which they are best suited; by supervisors not showing any partiality; by advising men in regard to shop rules and warning them if minor violations occur; showing appreciation for an extra good job performed in quick time and loyal service in emergencies; rewarding special ability when possible; by not holding out any promises except those that the company is able to keep; not blaming employees for mistakes in workmanship beyond their control or which rightfully belong to the supervisor or some other employee; by enforcing sanitary and safety rules and the prevention of accidents; disciplining the careless man; furnishing supplies and materials as promptly as possible; giving men safe and sufficient tools for the job; explaining the job properly to the man before he proceeds with it; not shifting men from job to job any more than is necessary; specializing in output; and by more careful inspection of work performed.

Materials and supplies, and their relation to production to avoid delay to equipment, requires the closest co-operation between the stores departments and the shops. An oversupply is tying up money needed elsewhere and an undersupply is tying up valuable equipment.

A proper, but not too elaborate, cost accounting system is necessary as a measuring stick of the output in relation to man-hours, etc.

Scheduling systems for locomotive and passenger cars are now the rule. However, in freight car repairs the conditions are so varied that different shops use different methods. The station-to-station method of repairing freight cars should be used and extended as much as possible.

The Spirit That Counts

Generally speaking, there must be enthusiasm and a spirit of co-operation to make shop management most successful. It is the spirit that counts and this impels me to tell the following story: "Before the days of the Eighteenth Amendment there was a master down in Dixie-land who gave a special reward to his faithful colored servant upon leaving his service, in the shape of a bottle of brandied peaches. A few weeks later the former servant called at the house and his ex-master asked him how he had liked the bottle of brandied peaches. Said the colored man, 'Well, sah, those peaches, they was all right, but I liked the spirits better in which they were given.' "

D. & H. Passenger Train of the Civil War Days

Classification of Locomotive Repair Shops

Analysis of Shop Operations with the Object of Reducing Expenses and Facilitating Repairs

By George Armstrong

TRANSPORTATION is the primary function of a railroad. In producing this service, the railroads must give more and more attention to proper functioning of motive power and rolling stock.

Increased capacity will be demanded of the railroad machine in the future. Increased capacity with economical service requires the greatest result from the least investment and the minimum expenditure of labor. Cognizance must be taken of the definite relationship between the transportation requirements and the rolling stock and locomotives to handle the traffic. Either new equipment will be needed to provide increased capacity or more effective service must be obtained from existing equipment. The attainment of the most economical service calls for determining the economic balance between the investment in new cars and locomotives, with the attendant burden upon maintenance facilities, and the investment in additional and improved shop equipment and facilities to maintain the locomotives and cars.

Non-Productive Time Spent in Engine Houses

There is considerable room for study of this balance in the increasing of a road's capacity. This is shown by the fact that while the United States Railroad Administration's distribution of locomotive hours showed an average time in road and switching service of 78 per cent of all serviceable locomotives, or an actual effective service of about 40 per cent, individual road returns showed a minimum as low as 14 per cent in road and switching service and a maximum of about 60 per cent. Approximately 50 per cent of the balance of locomotive service time was spent in the enginehouse.

A portion of this non-productive time is undoubtedly due to operating conditions, but a considerable portion is doubtless due to the delay in handling engines through poorly laid out and congested engine terminals, or while making necessary repairs in enginehouses that are inadequately equipped to do the work.

Increasing Actual Working Time

The effect of increasing the proportionate time of road and switching service from 40 to 45 per cent with 500 locomotives would be equivalent to the addition of 45 engines, assuming 80 per cent were in serviceable condition. In other words, without this increase in the effective service of a locomotive, it would be necessary to add 45 locomotives to the 500 already owned in order to deliver the same number of locomotive hours of service daily.

Many roads in the past have increased their capacity by adding new equipment when better equipped roundhouses and shops would have secured the same results, especially in the case of the roundhouse. But money can be borrowed by means of equipment trusts to finance the purchase of new locomotives more readily than it can be secured for improvements to existing facilities. This has been the main reason for increasing hauling capacity in the past rather than by improving terminal facilities. The solution lies in a careful business study leading to a conviction of the economic value of a depreciation fund, not as an account but as a reserve for shop and terminal improvements. A reserve fund should be available that can be drawn upon to replace obsolete or inadequate equipment.

Reduction of Unserviceable Locomotives

Another aspect of the possible increase in the capacity of a railroad due to better terminal facilities should be in the reduction of unserviceable locomotives, such as those held for classified repairs or repairs of over 24 hours' duration. The average number as indicated from the Railroad Administration figures just quoted was 77.6 per cent in serviceable condition, with a minimum of 66.3 per cent and a maximum of 87.5 per cent.

The effect of increasing the percentage of serviceable locomotives from 80 to 85 per cent, in the example of the 500 locomotives, would add 25 serviceable locomotives to those obtained by securing more effective service from the engines already in service. Increasing by five per cent the time of serviceable locomotives in road and switching service and decreasing by the same percentage the unserviceable locomotives, there could be secured the same amount of work from 500 locomotives as could be secured from 570 locomotives without any improvements to the locomotives already owned. Increased capacity by determining the economic balance between an investment in new rolling stock and locomotives, or an investment in additional shop equipment and improvements, demands that terminal facilities should be carefully designed with a view to best meeting future requirements. Labor costs, despite any further deflation from present levels will doubtless be higher than those existing prior to 1914 or 1915. Honest, efficient and economical service demands the largest possible return from every dollar of wages paid.

Three Divisions of Shop Classification

The system of shop facilities to best meet the new situation comprises three divisions. First, a roundhouse with an auxiliary machine shop having a pit capacity for two or more locomotives. This roundhouse to be located at each large division point or at every other division point. The auxiliary shop to be devoted exclusively to the making of heavy running repairs. Second, an intensive locomotive repair shop for repairing locomotives only. This shop should make no heavy running repairs or do any manufacturing work. It should be designed with a view to making quick repairs to a small number of engines in the shop at one time. Third, a centralized production or manufacturing shop. There should be a separate organization capable of finishing all repair parts not standard commercial articles, which can be completely finished or semi-finished ready for use in the repairing of locomotives.

Proper Use of Roundhouses

A roundhouse is primarily designed for the housing of locomotives and is not well adapted to the making of extensive repairs. On the other hand, a repair shop cannot properly function if the making of classified repairs is to be continually interrupted in order to take care of heavy running repairs. Consequently, the making of heavy running repairs and monthly boiler washing and repairs should be performed in an auxiliary shop operated in conjunction with the roundhouse. This should eliminate a great amount of unnecessary running back and forth from the machine to the work when the repairs are being made at some point in the roundhouse. This arrangement will permit the proper supervision of heavy running repair forces and will reduce the unsupervised force

to a minimum on account of the fact that only minor repairs and adjustments would be made in the roundhouse proper. Such an auxiliary shop should be considered at each important division terminal, also on a great many roads where intermediate terminals are simply turn-around points.

An auxiliary shop at every second divisional terminal should be adequate to meet all requirements of the roundhouse. The exact division allocation of these auxiliary shops can only be determined after a careful study of the operating conditions. Sufficient auxiliary shops should be provided to adequately maintain power between shoppings for classified repairs.

A great deal of needless expenditure for maintenance of equipment in roundhouses is incurred through the practice of patching just enough to allow the engine to make another round trip or two. This is not only a waste of money, but frequently results in the necessity for a great deal more work to be done when real repairs are made. It is also an important factor towards decreasing the mileage as well as increasing the length of time required to be spent in the shop for classified repairs.

If the locomotive requires work to be done on any portion of the rods, wheels or cylinders, which, outside of the boiler work, constitutes the major portion of roundhouse repairs, careful attention should be given to such repairs in order that when the engine is returned to service it will not return again within a short time. Careless work usually requires early removal from service in order that attention can be given to some other portion of the same machinery. If the lateral is required to be taken up on one pair of driving wheels, the others should receive attention at the same time in order that, when a month or six weeks roll around, it will not be necessary to remove the same locomotive from service to take care of the remaining wheels.

The Auxiliary Repair Shop

Some objections will no doubt be presented to the practice of operating an auxiliary shop because there is a duplication of equipment. Inasmuch as the average investment for shops and enginehouses, which includes car repair shops, amounts to approximately 50 per cent of the investment in locomotives. It is believed that a careful, analytic study will justify the triple grouping of mechanical facilities as previously outlined. The equipment of an auxiliary repair shop should include some means for removing wheels of locomotives either by a drop pit or with a Whiting locomotive hoist. A ten or fifteen ton traveling crane over the erecting shop portion and the wheel turning and tire boring machine should also be installed. Other machine tool equipment should include a crank shaper or crank planer, a 36-in. vertical or radial drill press or heavy duty drilling machine, a 36-in. engine lathe, two 16-in. by 8-ft. or 20-in. by 8-ft. engine lathes, an electric welder, 36-in, punch and shear, 150-lb. hammer, flue cutter and such minor equipment as may be necessary.

Aside from the physical aspect of the engine terminal in relation to the efficient repair of locomotives, attention should also be given to such details of terminal layout as will expedite outside operations and afford the maximum time available for making adjustments and minor repairs.

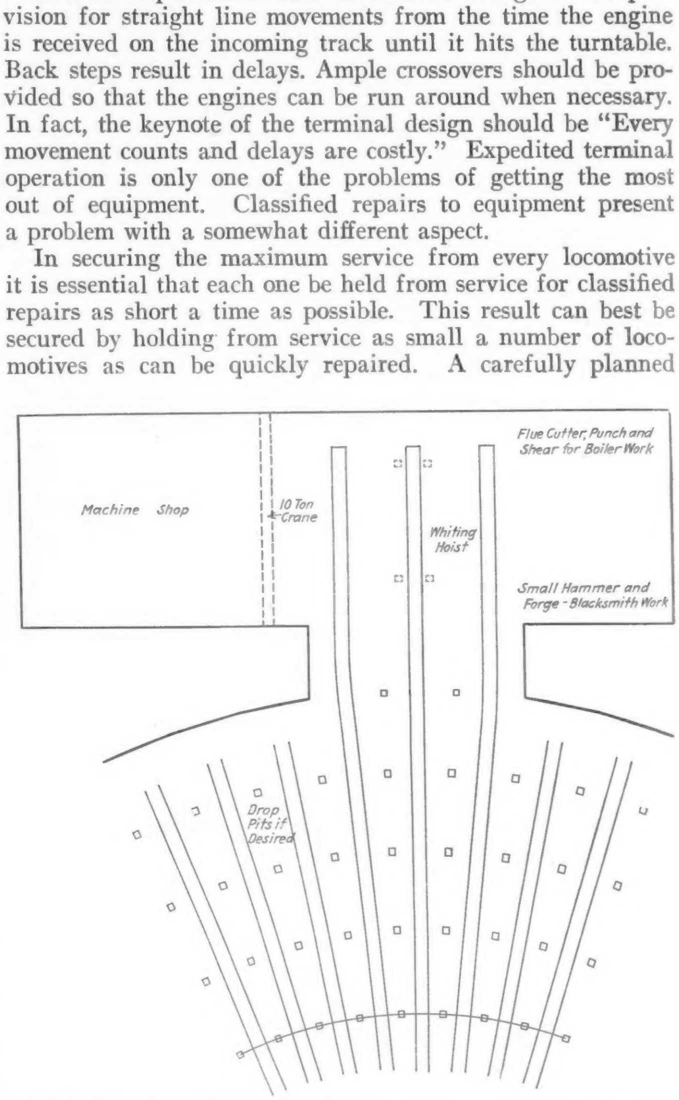
Outlying Inspection Shed and Pit

Foremost among these provisions is that of an outlying inspection shed and pit at all terminals handling 24 or more engines daily. Through such a system advance notice of heavy repair requirements can be obtained. Preparation for the necessary work can be made and it can be determined whether the engine will be diverted to the auxiliary shop or repaired outside. At the same time the inspector or his helper can attend to many minor defects as they are revealed, thus eliminating any possibility of their being overlooked. This will also do away with the unnecessary expense incident to making out a report for some one to apply a cotter, tighten nuts or replace a missing nut.

Provision for Straight Line Movements

Another important feature of terminal design is the provision for straight line movements from the time the engine is received on the incoming track until it hits the turntable. Back steps result in delays. Ample crossovers should be provided so that the engines can be run around when necessary. In fact, the keynote of the terminal design should be "Every movement counts and delays are costly." Expedited terminal operation is only one of the problems of getting the most out of equipment. Classified repairs to equipment present a problem with a somewhat different aspect.

In securing the maximum service from every locomotive it is essential that each one be held from service for classified repairs as short a time as possible. This result can best be secured by holding from service as small a number of locomotives as can be quickly repaired. A carefully planned shop with a balanced quota of machine tools suitable for doing the work can, under good management, literally "push an engine through."



Arrangement of Auxiliary Shop Operated in Conjunction With Roundhouse

Employment of Scheduling System

In securing this result more is demanded, however, than a shop. Advance information must be furnished at least two months previous to the time the engine is to be shopped as to what major parts, such as cylinders, wheel centers, deck castings, flue sheets, etc., will require replacement. These should be ordered long enough in advance that they may be available at the time the engine comes into the shop for repairs. A scheduling system must be employed that schedules, not one that merely indicates what is to be desired. Railroad trains are not scheduled over a division according to the desire of the various individuals operating the trains. They are scheduled in accordane with a careully worked out time card and although this is not always lived up to, any deviations therefrom are charged up as delays. The same should be true of a shop scheduling system. Careful analysis, preferably on a man-hour or shop-hour basis, should be made and once having established a

schedule, every effort should be made to adhere to it. If subsequent results indicate that a change in the schedule is required, then that change should be made in the master schedule.

A cost accounting system should be installed. It is absolutely impossible to secure any comprehensive information as to the cost of repairing locomotives, if the foreman or workman is depended upon to allocate the expense. The average workman is not a good timekeeper or bookkeeper and it is an injustice to the foreman to expect him to properly supervise and at the same time do such work. A simple, comprehensive cost system would be one allocating repair costs to the major units of a locomotive; for instance, to rods, firebox, cylinders, wheels, cab work, etc. Overhead distribution should be made by departments and some system of time keeping with time keepers located in each department, should be employed.

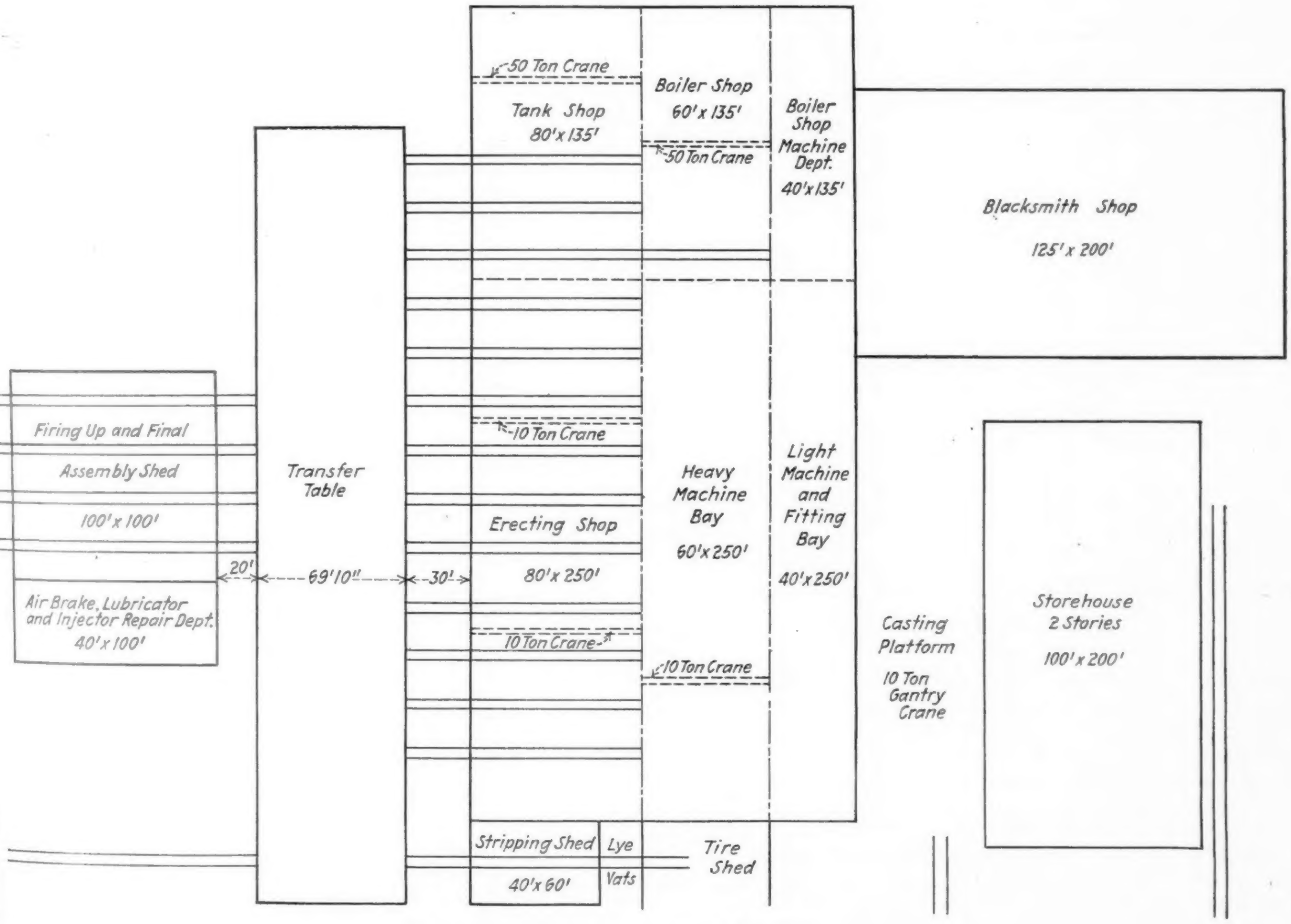
All material disbursements should be made by the stores department direct to the machine or locomotive or other designated place for its delivery. A desirable system of ordering material would be to employ the telephone with instruments conveniently located for the foreman. This places the responsibility for the proper charging out of any material on the dispatching clerk in the storehouse. At the same time he could issue the necessary order to a material runner who would either deliver the material or see that it was placed at the loading station for the next electric delivery truck.

Transverse Shop the Most Serviceable

Let us consider the shop itself. Where sufficient ground area is available, a transverse shop is perhaps the most desirable. This will permit the most economical construction inasmuch as it can be built without the necessity for installing cranes of large capacity.

A separate stripping shop should be located immediately adjacent to the erecting shop, preferably at one end. This segregates the dirt and confusion attendant upon stripping locomotives. It should be equipped either with two heavy cranes or a Whiting locomotive hoist for wheeling and unwheeling locomotives, also a 15-ton crane for removing heavy parts. Adjacent to the stripping shop there should be a lye vat of ample size to receive rods, driving wheels and even engine and trailer trucks served by the 15-ton crane. Distribution of clean material can be effectively made to all departments from the lye vat.

This arrangement requires the installation of sufficient 15 or 20-ton cranes in the erecting shop to obtain a flexible system of operation. Each erecting gang can be given its own crane. This also permits the construction of a more economical shop.



Tentative Layout of a Departmental Shop

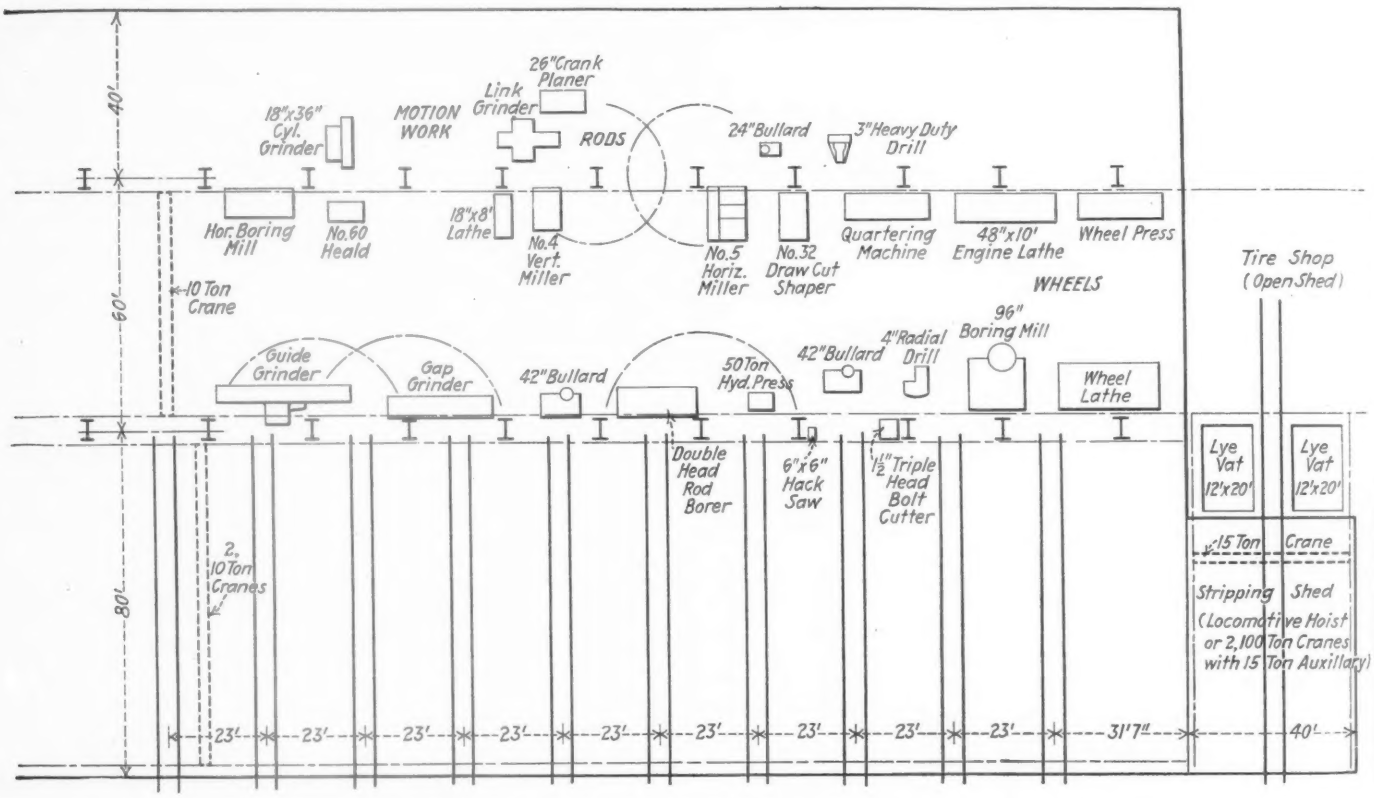
The departmental layout of such a shop should be such that all material can be moved without back tracking. A tentative layout of a transverse shop with 13 erecting pits is shown in the plan above. Where the output of the shop exceeds 10 engines, it will be necessary to provide an additional stripping track. This is essential so that the engine being stripped will not tie up the hoist except for wheeling and unwheeling operations.

The Fire-Up Shed

The firing-up and final assembly shed should be located adjacent to the air brake, lubricator and injector repair departments. These are the departments most concerned.

with the engine during the final assembly, and its subsequent fire-up test.

Another innovation that should be utilized in conjunction with the fire-up shed is a winch operated valve setting machine. Parts of valve gears should be carefully checked as to lengths and set. If they agree with the drawing requirements, it is only possible to alter or correct valve setting through altering the valve or eccentric rods in the case of outside valve gears. The best method of accomplishing this is by running over the valves of a locomotive while hot. A slow speed push button control, reversible electric winch with an endless cable, provided with chain loops for attaching to the locomotive can provide the motive power for the running over movement. The locomotive can be secured to this cable by means of turn-buckle devices, and moved over a distance of approximately forty feet. This should be more than enough for a complete revolution of any size of wheels. Limit controls could be utilized to prevent overrunning.



Arrangement of the Machine Shop and Erecting Shop With an Adjacent Stripping Shed

Straight Line Repair Shop

The straight line locomotive repair shop* would also be suitable for a repair shop of this character, provided a fire-up shed were placed at the end of the outgoing track with sufficient switches to permit the handling of engines on several tracks at this point. The fire-up shed should have the air brake, injector and lubricator departments placed as previously described.

Longitudinal Erecting Shop

A longitudinal erecting shop with one running track only could be substituted for the transverse shop. Stripping could then be done at one end of the shop and assembly done at the other end, with a fire-up shed for final assembly and test. Engines undergoing repairs would be set off at a slight angle supported on built-up structural steel pedestals to permit the removal of flues and their application. The use of pits in an erecting shop floor, either the transverse or longitudinal type is not required, except in stripping and assembly work. Otherwise, pits are apt to become a catch-all as well as an obstruction in the floor. They also tend to absorb light that otherwise might be reflected against the under portion of the locomotive on the pit.†

The equipment and scope of repair operations in an intensively operated locomotive repair shop are shown in the table. This also gives the proportion of a month's operation which the repair requirements for each engine will demand from each machine. This analysis is not to be considered as absolutely accurate, but represents the best possible study for repairing parts for heavy Consolidation or Mikado type locomotives, with new parts secured from a manufacturing shop.

Separate Organization for Manufacturing

The manufacture of locomotive and car repair parts, that are not commercially standard products can only be handled economically by an entirely separate organization. The equipment required for quantity production is different from that demanded for the repair of parts in small quantities. The attitude of the management in quantity production must be totally different from that required to cope with the problems of repair work.

Every part that can be completely finished ready for application or can be partly furnished and produced in quantity should be made in such a manufacturing or centralized production shop. Care should be taken, however, not to encroach upon the realm of commercially standard products. The manufacturing shop usually keeps a record of disbursements indicating the consumption at various points for all its products and also maintains an inspection organization capable of looking after manufacturing inspection, and also following up the kind of service rendered. A railroad,

*The straight line locomotive repair shop referred to here was described in the October 27, 1923, number of the *Railway Age*, page 767; the October 1923, *Railway Mechanical Engineer*, page 714.

†An erecting shop of the type referred to herein was described in the September, 1923, *Railway Mechanical Engineer*, page 615.

through this service, is in possession of a very valuable adjunct in effecting a reduction in the cost of maintenance of equipment. Control over the use and consumption of material and the knowledge of its performance should be available both for the mechanical and the stores departments. This is an invaluable aid in securing economy.

Analysis of Shop Operation

Based on General Repairs to Consolidation or Mikado type locomotive. Shop working eight hours per day

Operation	Repairs per engine		Average time per piece		Time		Proportion months operation
	Pairs	Pieces	Hr.	Min.	Hr.	Min.	Per Cent
Stripping Shop							
Engine stripped complete. All material cleaned and distributed	..	..	..	..	..	..	..
Erecting Shop							
Frame jaws squared, frame bolts renewed, shoes and wedges laid out, pedestal binders refit, cross braces rebolted if necessary	..	..	..	..	..	..	..
Spring rigging applied	..	..	..	..	..	..	..
Cylinders rebored, valve chamber bushings rebored or applied, guides lined, pistons applied and heads up	..	..	..	..	..	..	..
Engine wheeled and rods applied	..	..	..	..	..	..	..
Motion work applied, valves set and reverse gear up	..	..	..	..	..	..	..
Steam pipes, dry pipe, throttle and exhaust pipe applied. Superheater units and header applied and tested	..	..	..	..	..	..	..
Front end netting applied	..	..	..	..	..	..	..
Cab valves and fittings overhauled and safety valves set	..	..	..	..	..	..	..
Stoker applied, if used	..	..	..	..	..	..	..
Running boards, cylinder and dome castings, smoke box front applied	..	..	..	..	..	..	..
Air pump, reservoirs, brake cylinders and brake rigging applied	..	..	..	..	..	..	..
Jacket and lagging applied	..	..	..	..	..	..	..
Piping applied	..	..	..	..	..	..	..
Ashpans applied	..	..	..	..	..	..	..
Engine painted and lettered	..	..	..	..	..	..	..
Wheel Work							
Driving wheel tires turned	..	..	..	..	..	..	..
Crank pins quartered or new pins applied	..	..	..	..	..	..	..
Driving journals trued	..	..	..	..	..	..	..
Engine truck, trailer truck and tender truck tires turned, if steel	..	..	..	..	..	..	..
New wheel centers, crank pins and axles from manufacturing shop. Wheel centers should be turned and faced to standard, tires bored standard and lipped possibly at main shop. Crank pins finished complete except wheel fit	..	..	..	..	..	..	..
Engine truck, trailer truck and tender truck wheels mounted at main shop together with car wheels	..	..	..	..	..	..	..
1 90-in. wheel lathe turning tires	4	..	1	30	6	..	..
Truing journals	..	4	2	30	10	..	8
Note.—Used also for quartering wheels unless quartering machine is provided.							
1 96-in. vertical boring mill							
Boring tires	..	1½	1	..	1	30	..
Wheel centers, if not produced at main shop	..	¼	8	..	2	0	1.75
1 Quartering machine							
Quartering wheels	..	1	3	..	3	..	1.5
See note, on 90-in. wheel lathe.							
1 400-ton wheel press mounting and dismantling wheels	..	..	..	..	..	..	..
Pressing in pins	..	..	..	..	..	..	..
Piston and Cylinder Work							
New pistons fit and applied	..	..	..	..	..	..	..
Grooves in old pistons trued up	..	..	..	..	..	..	..
Piston rods ground	..	..	..	..	..	..	..
Cylinder head joints renewed	..	..	..	..	..	..	..
Cylinder bushings fit	..	..	..	..	..	..	..
Piston rod packing applied	..	..	..	..	..	..	..
New cylinder heads, piston bull rings, cylinder head studs, cylinder packing and piston rods from manufacturing plant finished	..	..	..	..	..	..	..
Cylinder bushings and valve bushings bored, ports milled and rough turned from manufacturing plant	..	..	..	..	..	..	..
New cylinders, purchased or from manufacturing shop	..	..	..	..	..	..	..
1 Gap grinder. Grind piston rods	..	2	..	40	1	20	..
Grind driving axle wheel fits	..	¼	..	45	..	12	..
Grind engine truck wheel fits	..	¼	..	40	..	12	..
Grind tender truck axle wheel fits	..	½	..	40	..	20	..
Grind crank pin, wheel fits	..	1	..	30	..	30	..
Grind valve stems	..	..	..	45	..	..	..
Grind valve yokes	..	2	..	35	1	20	2
1 48 in. by 18 ft. engine lathe							
Return piston heads	..	2	1	45	3	30	..
Fit cylinder bushings	..	1	4	..	4	..	..
True piston head grooves	..	2	1	30	3	..	..
True lift shaft bearings	..	.2	..	40	..	2	..
True rocker arms, when used	..	..	..	..	..	..	..
True engine truck and trailer journals	2	..	1	30	3	..	..
Fit piston rods to crosshead	..	.3	1	15	..	24	7.1
1 42-in. vertical turret lathe							
Fit piston heads	..	.8	1	30	1	12	..
Face cylinder head joints	..	.5	..	50	..	24	..
Fit valve chamber bushings	..	2.0	1	15	2	30	2
Piston Rod Packing							
Note.—See Cab Work.							
Valves and Valve Gears	..	..	..	..	..	..	..
Renew pins and bushings	..	..	..	..	..	..	..
Refit link and link block	..	..	..	..	..	..	..
Straighten valve rods and adjust to standard	..	..	..	..	..	..	..
Overhaul piston or slide valves	..	..	..	..	..	..	..
Overhaul reverse levers. Note.—Power reverse gear to air brake dept	..	..	..	..	..	..	..
Valve stem packing fitted	..	..	..	..	..	..	..
New valve gear parts, reverse lever latches, piston valve parts, valve packing rings, valve yokes, slide valves, valve strips, valve springs and valve stems from manufacturing shop finished	..	..	..	..	..	..	..
Motion work pins and bushings and eccentrics and straps, if used, from the manufacturing shop semi-finished	..	..	..	..	..	..	..
1 Internal grinder							
Grind bushing holes, motion work		12 holes	..	30	6	..	..
Grind knuckle pin holes in side rods		4 holes	..	45	3	..	4.5
1 18 in. by 36 in. cylinder grinder							
Fit motion work bushings	..	12	..	10	2	..	..
Fit motion work pins	..	14	..	15	3	30	2.75
1 Link Grinder							
Grind link radius	..	2	2	..	4	..	..
Grind link block	..	2	1	..	2	..	3.0
1 Guide grinder							
Re-surface guides	..	4	..	30	2	..	..
Re-surface slide valves	..	*2	..	..	..	..	..
Grind valve strips	..	*8	..	..	..	..	..
Re-surface pressure plates	..	*2	..	..	..	..	..
Total	..	..	..	..	..	..	*1.0
1 42-in. Vertical turret lathe							
Re-bore eccentric straps	..	*4	..	..	..	..	..
Return eccentrics	..	*4	..	..	..	..	..
True dome caps	..	0.2	2	..	..	24	..
Bore and face hub liners, driving boxes	..	8	..	45	6	..	..

*Only in case of old power.

Operation	Pairs	Pieces	Hr.	Min.	Hr.	Min.	Per Cent
Engine truck center castings, rebored	..	.5	2	..	1	..	3.75
Valve stem packing bored	..	..	..	..	..	..	..
Note.—See Cab Work.							
Driving Box Work							
Driving box shoe and wedge ways brought back to standard	..	..	..	..	..	..	..
New driving box brasses applied and bored	..	..	..	..	..	..	..
Cellars refit	..	..	..	..	..	..	..
Hub liners, driving box, applied and faced	..	..	..	..	..	..	..
Spring saddle pockets, driving boxes milled	..	..	..	..	..	..	..
Oil grooves cut in driving boxes	..	..	..	..	..	..	..
New driving boxes complete ready for brass from manufacturing shop	..	..	..	..	..	..	..
1 4-ft. radial drill press							
Drill boxes for oil holes	..	..	..	..	..	..	..
Drill cylinder heads if impossible to drill standard at manufacturing shop	..	..	..	..	..	..	..
1 Draw cut shaper							
Plane shoes and wedges to line	..	8	..	15	2	..	..
Plane driving box brasses	..	8	..	20	2	35	..
Refit pedestal braces	..	8	..	30	4	..	..
Recut guide clearances	..	4	..	15	1	..	..
True driving box shoe and wedge ways	..	8	..	30	4	..	..
Fit driving box cellars (or preferably on guide grinder)	..	8	..	30	4	..	..
Square up spring saddles	..	8	..	15	2	..	9.75
Brasses bored and hub liners faced. Note.—See vertical turret lathe, valves and valve gears	..	..	..	..	..	..	..
Frame Work							
Shoes and wedges planed to line	..	..	..	..	..	..	..
Pedestal braces refit	..	..	..	..	..	..	..
Frame braces jaws refit after closing or welding on new ends	..	..	..	..	..	..	..
Frame bolts fitted	..	..	..	..	..	..	..
New shoes and wedges from manufacturing shop	..	..	..	..	..	..	..
Bolts turned to taper and standard sizes from manufacturing shop and holes reamed for bolts	..	..	..	..	..	..	..

Operation	Repairs Pairs	Repairs Pieces	Average time per piece Hr.	Average time per piece Min.	Time Hr.	Time Min.	Proportion months operation Per Cent
New frames and parts from manufacturing shop or frames preferably purchased already finished	..	..	..	..	..	..	..
Shoes and wedges planed and pedestal braces fit. Note—See draw cut shaper driving boxes	..	..	..	..	..	..	..
1 6-in. by 6-in. power hack saw—Cut taper bolts to length for threading	..	..	..	..	..	..	..
1 1½-in. triple head bolt cutter—Threading taper bolts after cut to length	..	..	..	..	..	..	..

Guide Work

Operation	Repairs Pairs	Repairs Pieces	Average time per piece Hr.	Average time per piece Min.	Time Hr.	Time Min.	Per Cent
Guides straightened and ground	..	..	..	..	..	..	..
Recut guide clearances	..	..	..	..	..	..	..
New guides and guide blocks from manufacturing shop finished	..	..	..	..	..	..	..
Note.—See guide grinder, motion work and draw cut shaper, driving boxes.							

Spring Rigging Work

Operation	Repairs Pairs	Repairs Pieces	Average time per piece Hr.	Average time per piece Min.	Time Hr.	Time Min.	Per Cent
Spring hangers and equalizers bushed	..	..	..	..	..	..	..
Spring saddles squared	..	..	..	..	..	..	..
New spring saddles, spring pins and clips from manufacturing shop finished. Springs repaired or new from manufacturing shop or purchased	..	..	..	..	..	..	..
1 3-ft. Heavy duty vertical drill							
Bore spring hangers for bushing (or after holes are plugged)	24 holes		5	..	5	..	..
Bore springs equalizers for bushing	12 holes		4	..	4	..	..
Bore brake hangers for bushings	16 holes		4	..	4	..	..
Bore and ream crosshead for pin fit	..	2	1	..	3	..	..
Ream for new crosshead shoes, if bolted	16 holes		1	..	1	..	8.5
Note.—See also draw cut shaper under Driving Box Work.							

Foundation Brake Rigging

Operation	Repairs Pairs	Repairs Pieces	Average time per piece Hr.	Average time per piece Min.	Time Hr.	Time Min.	Per Cent
Brake rods and levers overhauled	..	..	..	..	..	..	..
Brake cylinder packing leather renewed and cylinder greased	..	..	..	..	..	..	..
Brake hangers overhauled and new shoes secured	..	..	..	..	..	..	..
New brake, rod jaws, adjusting rods, levers and hangers from manufacturing shop. Brake pins purchased	..	..	..	..	..	..	..
Note.—See 3-in. heavy duty vertical drill, spring rigging work.							

Crosshead Work

Operation	Repairs Pairs	Repairs Pieces	Average time per piece Hr.	Average time per piece Min.	Time Hr.	Time Min.	Per Cent
Babbitt crosshead shoes for guides	..	..	..	..	..	..	..
Ream and bolt new crosshead shoes	..	..	..	..	..	..	..
Ream for crosshead pin	..	..	..	..	..	..	..
New crossheads complete from manufacturing shop and shoes complete ready to ream	..	..	..	..	..	..	..
Note.—See 3-in. heavy duty vertical drill, spring rigging work.							

Steam Pipes, Throttle and Superheater Work

Operation	Repairs Pairs	Repairs Pieces	Average time per piece Hr.	Average time per piece Min.	Time Hr.	Time Min.	Per Cent
Steam pipe, dry pipe and exhaust pot joints ground	..	..	..	..	..	..	..
New joint rings, if necessary for steam pipes and dry pipe	..	..	..	..	..	..	..
Exhaust nozzle renewed	..	..	..	..	..	..	..
Superheater header and unit joints ground	..	..	..	..	..	..	..
Superheater units repaired	..	..	..	..	..	..	..
Throttle rigging overhauled	..	..	..	..	..	..	..
New steam pipes, exhaust pots, throttle valves, standpipes and throttle lever latches from manufacturing shop finished	..	..	..	..	..	..	..
1 horizontal boring, drilling and milling machine							
True up steam pipe joints	..	8	2	..	1	36	..
Rocker boxes rebored	..	.2	2	..	..	24	..
Rebore throttle box	..	.5	1	..	..	30	1.25
Exhaust nozzles ground from rough castings	..	..	..	..	..	..	..
Note—See grinder, valves and valve gears.							
1 6-in. by 6-in. power hack saw							
Repairs to superheater units	..	..	..	..	..	..	..
1 power pipe threading machine							
Repairs to superheater units	..	..	..	..	..	..	..
1 18-in. engine lathe							
Machine steam pipe joint rings	..	1	1	..	1	..	..
True up throttle valve seat	..	.3	1	30	..	27	..
Face crank pin nuts and washers	..	2	..	15	..	30	1

Rod Work

Operation	Repairs Pairs	Repairs Pieces	Average time per piece Hr.	Average time per piece Min.	Time Hr.	Time Min.	Per Cent
Rods overhauled	..	..	..	..	..	..	..
New crank pin rod bushings applied	..	..	..	..	..	..	..
New knuckle pins and bushings fit	..	..	..	..	..	..	..
Rod straps, front or back solid end main rods milled	..	..	..	..	..	..	..
Rod brasses renewed	..	..	..	..	..	..	..
Bushings and brasses bored	..	..	..	..	..	..	..
New rods, rod straps, crank pin collars, wrist pin collars, rod dowels, rod wedges, oil and grease cup parts from manufacturing shop finished. Knuckle pins and rod brasses semi-finished. Bolts turned taper ready to thread, holes reamed to suit	..	..	..	..	..	..	..
1 No. 4 heavy duty vertical milling machine							
Mill driving box saddle pockets	..	4	1	..	4	..	..
Mill rod straps to true	..	..	..	..	..	..	..
Mill solid end rods to true	..	4	1	..	4	..	4
1 24-in. vertical turret lathe							
Fit rod bushings	..	8	..	20	2	40	..
Bore and face rod brasses	..	4	..	30	2	40	2.7
1 26-in. crank planer or No. 5 heavy duty horizontal milling machine							
Finish rod brasses for strap	..	4	1	15	5	..	..
Finish wheel keys	..	2	..	25	..	48	..
Finish eccentric keys	..	2	..	25	..	48	..
Finish frame keys	..	.4	..	30	..	6	..
Finish guide blocks	..	.8	1	..	..	48	..
Finish rod keys	..	2	..	30	1	..	..
True up engine truck boxes	..	2	..	30	1	..	..
True up engine truck pedestals	..	1	..	45	..	45	5.1
1 Double spindle heavy duty rod boring mill or heavy duty vertical drill							
Bore rod bushings	..	8	..	30	4	..	..
Ream for knuckle pins	..	4	..	45	3	..	3.5
1 50-ton hydraulic press							
Apply rod bushings	..	..	..	..	..	..	..
Apply driving box brasses	..	..	..	..	..	..	..

Air Brake Work

Operation	Repairs Pairs	Repairs Pieces	Average time per piece Hr.	Average time per piece Min.	Time Hr.	Time Min.	Per Cent
Pump cleaned and overhauled	..	..	..	..	..	..	..
Engineer's valve cleaned and overhauled	..	..	..	..	..	..	..
Triple valves cleaned and overhauled	..	..	..	..	..	..	..
Power reverse gear overhauled	..	..	..	..	..	..	..
New parts purchased. Triple valves overhauled preferably at builders or manufacturing shop. Air pumps rebushed at manufacturing shop	..	..	..	..	..	..	..
Power reverse gear cylinder bored when necessary on horizontal boring mill, steam pipe work or ground, internal grinder, valves and valve gears	..	..	..	..	..	..	..

Cab Work

Operation	Repairs Pairs	Repairs Pieces	Average time per piece Hr.	Average time per piece Min.	Time Hr.	Time Min.	Per Cent
Injectors overhauled	..	..	..	..	..	..	..
Lubricators overhauled	..	..	..	..	..	..	..
Cab valves overhauled	..	..	..	..	..	..	..
Automatic fire doors overhauled	..	..	..	..	..	..	..
Gage cocks ground and overhauled	..	..	..	..	..	..	..
Water glasses and cocks overhauled	..	..	..	..	..	..	..
Repair parts purchased, except railroad companies individual standard valves, parts of which are secured from manufacturing shop	..	..	..	..	..	..	..
1 No. 4 turret lathe with side carriage							
Repairs on cab valves, boiler checks, etc.	..	..	6	..	6	..	..
Bore piston rod packing	2 sets		..	15	..	30	..
Bore valve stem packing	2 sets		..	12	..	24	..
Wash out plugs rechased	..	9	..	10	1	30	4.2

Engine Trucks

Operation	Repairs Pairs	Repairs Pieces	Average time per piece Hr.	Average time per piece Min.	Time Hr.	Time Min.	Per Cent
Engine trucks overhauled	..	..	..	..	..	..	..
New engine truck boxes and center castings from manufacturing shop finished	..	..	..	..	..	..	..
Engine truck boxes and pedestals trued	..	..	..	..	..	..	..
Note—See Rod Work.							
Engine truck center castings rebored	..	..	..	..	..	..	..
Note—See valves and valve gears.							

Miscellaneous

Operation	Repairs Pairs	Repairs Pieces	Average time per piece Hr.	Average time per piece Min.	Time Hr.	Time Min.	Per Cent
1 Sensitive drill press							
Miscellaneous small drilling	..	..	..	..	..	..	..

Boiler and Flue Shop

Operation	Repairs Pairs	Repairs Pieces	Average time per piece Hr.	Average time per piece Min.	Time Hr.	Time Min.	Per Cent
Flues							
1 Electric butt welding machine or rotary flue welding machine	..	..	..	..	..	..	..
Safe ending flues	..	..	..	..	..	..	..
1 Flue cutting off machine							
Cutting flues to length	..	..	..	..	..	..	..
1 Rotary swaging machine							
Swaging flues	..	..	..	..	..	..	..
Fireboxes							
Repaired and renewed	..	..	..	..	..	..	..
If justified, flues sheets and door sheets from manufacturing shop	..	..	..	..	..	..	..
Staybolts furnished in sets for new fireboxes, also for repairs from manufacturing shop	..	..	..	..	..	..	..
1 McCabe flanging machine							
If flues and door sheets are made in shop	..	..	..	..	..	..	..
1 6-ft radial drill							
Drilling flue sheets	..	..	..	..	..	..	..
Ash Pans							
Overhauled and new sheets and hoppers made	..	..	..	..	..	..	..
Ash pan rigging overhauled	..	..	..	..	..	..	..

General Equipment

Operation	Repairs Pairs	Repairs Pieces	Average time per piece Hr.	Average time per piece Min.	Time Hr.	Time Min.	Per Cent
1 1½-in. single end throat punch	..	..	..	..	..	..	..
1 1½-in. single end throat shear	..	..	..	..	..	..	..
1 Bending roll	..	..	..	..	..	..	..

Tool for Flanging Collars on Copper Pipe

By E. A. Miller

A TOOL that has been used successfully in railroad shop work for flanging collars on copper pipe is shown in Fig. 1. This tool does away with the use of the common brazed and ground joint used on injector and other copper piping. It consists essentially of a vise in which can be fitted different sized dies, one of which is shown in Fig. 2. A separate die is required for each size of pipe. The die is placed in the vise as shown by the dotted lines in Fig. 1. Behind the die piece is placed a filling piece, which has an opening to permit the pipe to extend through. This filling piece is used for all dies up to 2¼ in. pipe size. Above the die is placed a top piece on which the clamping screw turns. The clamping screw has a square head with a 12-in. handle and is screwed through a bushing in the top piece of the vise. This bushing is keyed in place, and can be easily removed. The vise arrangement itself is somewhat similar in construction to the ordinary pipe vise used for holding pipe while cutting or screwing on fittings. The yoke containing the screw is held in place by two links, to one of which it is permanently secured by a pin and cotter. The other link is securely latched in place as long as there is a load on the screw, but very readily releases when the screw is slack.

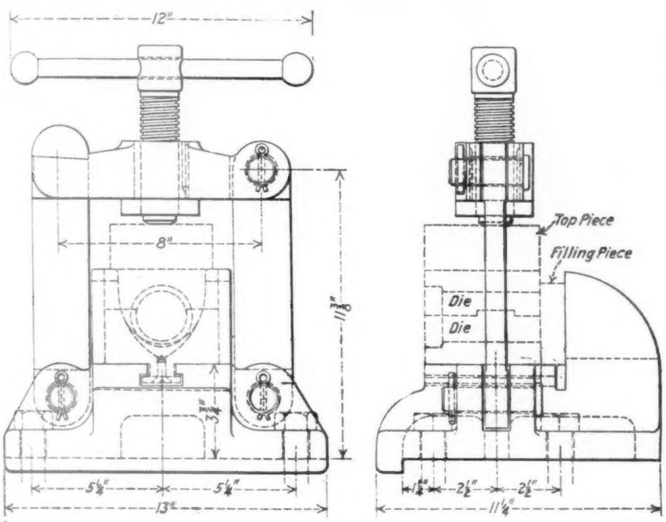


Fig. 1—Drawing of the Vise Showing the Die in Position

Size of Cu Pipe W.I. Pipe Sizes	Dimensions								
	A	B	C	D	E	F	G	H	I
3/8"	43/64"	1"	3"	5/16"	29/64"	2¾"	1 3/16"	1 1/16"	¼"
1"	1 5/16"	1⅝"	3½"	5/16"	½"	3⅝"	1 9/16"	1 9/16"	¼"
1¼"	1 21/32"	2¼"	3½"	¼"	25/32"	4"	1¾"	1¾"	3/16"

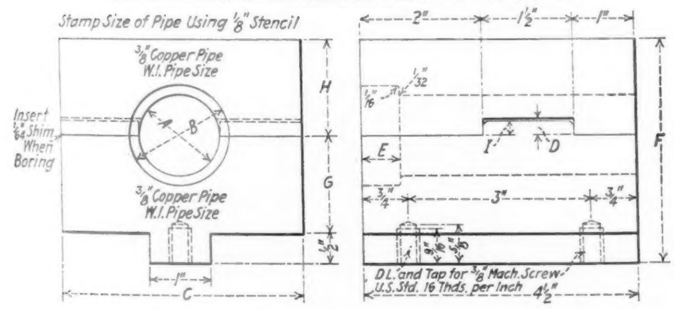


Fig. 2—Details of the Die Used for Holding the Pipe

The work to be done consists of four different operations. First, the pipe to be flanged is placed in the hole in the vise and then clamped securely. The end of the pipe is annealed. It is clamped in the die flush with the face to obtain the required material for gather. The second operation consists of expanding the end of the pipe. This is done by means of an expanding tool, of which there is one for each pipe size. Where this device is being used at the present time, there are ten different sizes of pipe to be taken care of. For these ten different sizes of pipe, there are, however, only two expanding tools needed, as one takes care of pipe up to and including 2 in., while the other takes care of pipe from 2¼ in. up to 3¼ in. inclusive. The third operation consists of the work of performing the actual flanging. A pneumatic hammer, in which has been inserted a die of the proper size, one of which is shown in Fig. 3, is used to do the work of flanging the pipe. During this operation the die should be rotated while driving with the air hammer. Upon the completion of the work of flanging, the fourth operation is performed, which consists of annealing the pipe.

It will be noted in Fig. 1 that provision is made for taking up the force of the blows of the hammer by a bracket on the base of the vise and the filling piece, which is inserted between this bracket and the die. The flanging dies are made of forged steel and are casehardened. The pneumatic hammer dies are made of tool steel with from 0.8 per cent to 0.9 per cent carbon and are heat treated. In order to distinguish the difference in the sizes of flanging dies and also of the pneumatic hammer dies, the size of the pipe for which they are to be used is stamped on them.

Collars for 2½-in. outside diameter copper pipe have been formed in 1½ min., leaving the collar in such shape as to require no subsequent machining to get a tight joint. This method is much quicker than the old method of turning up a brass joint, brazing it on the pipe and then grinding it in.

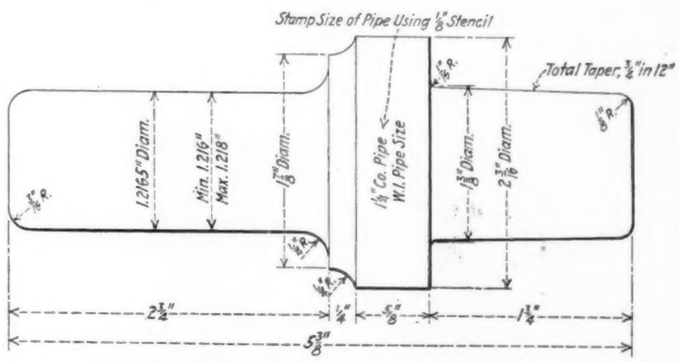
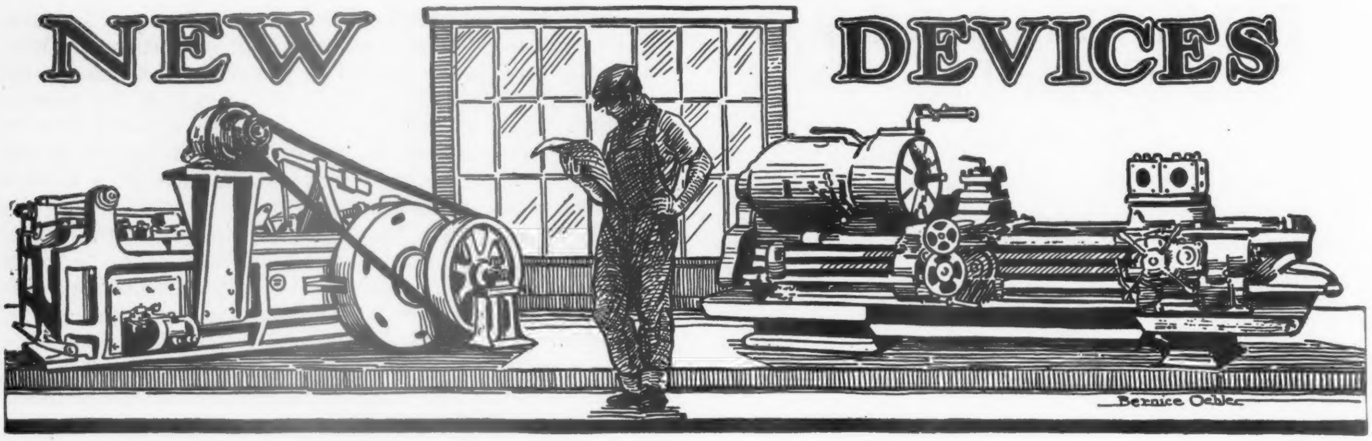


Fig. 3—Pneumatic Hammer Die for 1¼-Inch Copper Pipe

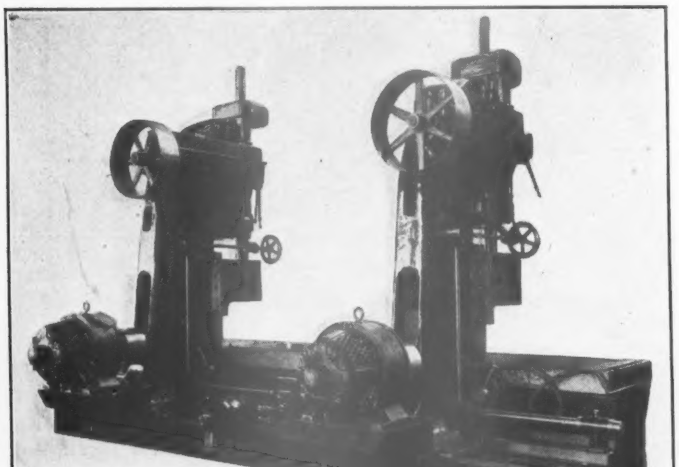
Thermit Preheater Burners

IN conducting some recent extensive experiments with different types of burners to be used in connection with standard Thermit preheaters' The Metal & Thermit Corporation, New York, found that the best results were secured with a burner pipe ⅜ in. in diameter, swaged down at one end and then drilled with 2 5/16-in. holes. Such a burner pipe fully atomizes the fuel before it enters the mold and gives the best combustion. When larger burners are used, or when ends are not swaged down, considerable air and fuel is wasted. The fuel does not become fully atomized with the result that raw oil is carried into the mold or is wasted by dripping from the end of the pipe.



Locomotive Rod Boring Machine

A TOOL designed to meet the needs of an extra stiff machine for boring outside rods, levers and heavy work of similar nature, has recently been placed on the market by Baker Brothers, Toledo, Ohio. It is a development of similar types covering a number of models built during the past 15 years. This development has resulted in a simple, rugged and efficient machine, which, while massive, is easily controlled. Particular attention has been paid to this feature in the design of this machine. Speed and feed changes can be made instantly. Each spindle is driven by a 15 hp. motor running at 1,200 r.p.m., constant speed. Where at all possible, the use of direct current is recommended. When direct current is used, the machine should be equipped with a series contactor, self-starter with a push

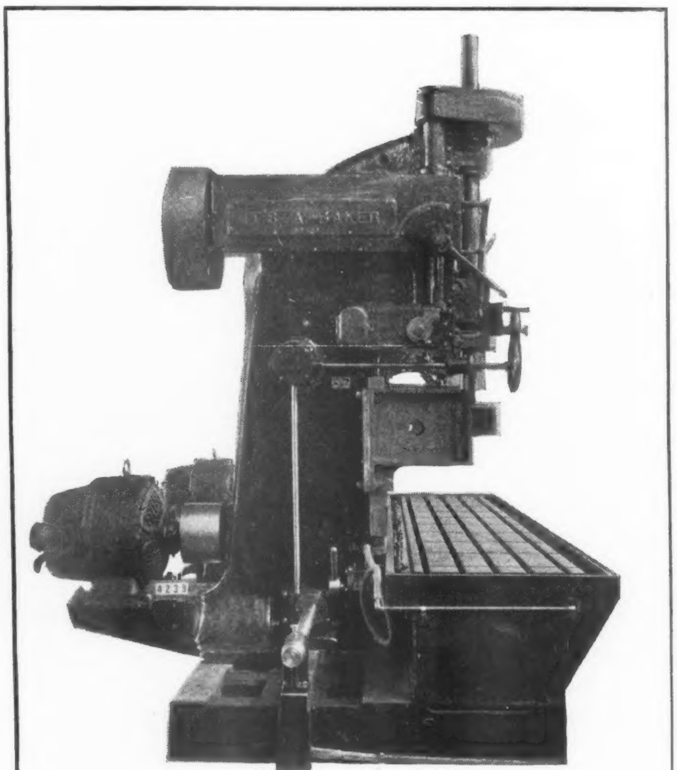


Rear View Showing the Separate Drives for Each Unit

button start, stop and reverse. This makes a much better arrangement and provides for tapping oil cups. Where alternating current only is available, a tapping reverse can be incorporated mechanically.

This machine has ample capacity to drive 5-in. high speed drills to the limits of their efficiency in steel. It is well adapted for heavy rapid boring, drilling, forming and facing. It can be used for boring and enlarging in steel and cast iron up to 14 in. It is equipped with a constant speed drive through a train of hardened gearing, running on annual ball bearings that are encased in an oil-tight box. No friction bearings are used.

Speed changes are obtained by means of sliding gears and can be made instantly. Only the minimum number of gears are running in mesh at any one time. The simplicity of the drive is one of its special features. There are no overhanging brackets or levers of complicated design either inside or outside of the gear box. The spindle is made of forged high carbon steel and is fitted with special chrome ball-thrust bearings. The spindle nose is bored for No. 6 Morse taper. It is slotted across the end for driving, bor-



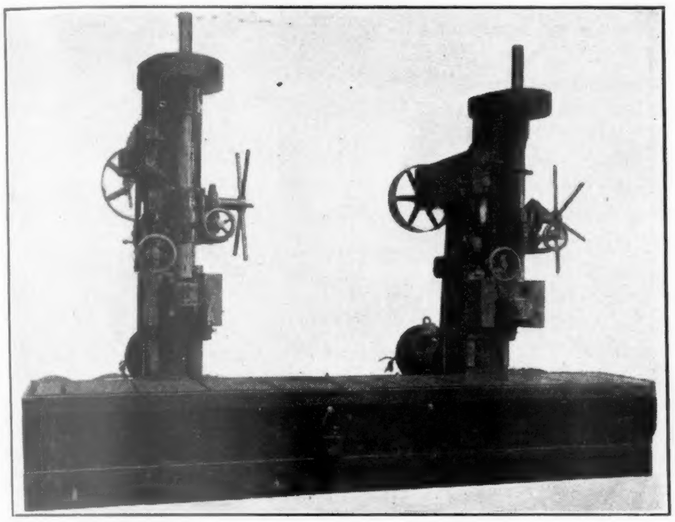
Side View Showing Method of Supporting the Boring Bars

ing and facing the heads and fitted with a cross drift for holding these heavy tools securely. In addition, it has a hollow set screw to prevent light tools from dropping out. The machine is equipped with a spindle fitted complete ready for any type of work.

The feed is provided with twelve drilling and twelve reaming feeds, twenty-four in all. The feed rack is of steel and the feed pinion that meshes with it is cut directly

on the shaft. Both units have independent drives and can be used with different speeds and feeds on different operations, if necessary. A large bronze worm gear is used for securing uniform wear and is secured to the shaft with a safety shear pin. This pin is set to shear at 14,000 lb. Capstan handles are provided for rapid traverse and in addition a hand worm feed is available.

The table is made up of a box section heavily ribbed, provided with heavy T slots, and has an oil tank extending its entire length. There is also a deep substantial groove for returning the cutting lubricant. A slot extends through the center of the table, in which are located two adjustable gibbed supports for the lower end of the boring bars. The boring bars are held by a rigid support, as shown in the side view. This support is adjusted vertically upon the gib ways by means of a handle. It consists of taper bushings, made adjustable for wear and assures rigid support of the boring tool directly above the work, eliminating any vibration and chatter. This permits the very heaviest feeds to be used. These supports can be used together or independently, making the machine practically universal for fitting in with the boring bar equipment. This makes the machine especially adaptable to meet the demands of different railroad shops.



Front View of Machine Tool for Boring Outside Rods

Each frame is an independent unit and is adjustable along the base either by hand or by power. A small motor is used for traversing the frames along the base. The frames are locked into position by air locks and the controls for both traverse and lock are located in front of the machine. All gears are completely guarded.

The specifications of the machine are as follows: Capacity of the high speed drill in solid steel is 5 in.; the distance from the center of spindle to the face of column, 18 in.; the distance from end of spindle to table, 30 in.; length of feed, 18 in.; diameter of spindle sleeve, 5.25 in., and least diameter of spindle, 3 5/16 in. Width of the steel feed rack, 2¼ in. The driving gear has a 2¾-in. face and is 18⅔ in. in diameter. There are twelve drilling feeds, .006, .007, .008, .010, .012, .013, .015, .017, .020, .028, .032 and .034, and twelve reaming feeds, .020, .023, .027, .033, .038, .044, .050, .057, .066, .081, .094 and .108. The minimum and maximum centers of spindle are 3 ft. 4 in. and 12 ft. 6 in., respectively. Eight speed changes, 11, 16, 20, 27, 61, 87, 111, 151, are provided. The driving pulley is 24 in. by 7½ in., and runs at a speed of 600 r.p.m. Two 15 hp., 1,200 r.p.m., and one 2 hp., 1,200 r.p.m., motors are required to operate the machine. It occupies a floor space of 8 ft. 0 in. by 17 ft. 2 in., and has a net weight of about 35,000 lb.

Small Crane for Railroad Service

THE light, general-purpose crane illustrated is now being produced by the Orton & Steinbrenner Company, Chicago, for use about railroad shops, enginehouses, scrap docks, yards, etc. It is designed for mounting on a flat car traveling the length of the car, revolving in a full circle, and yet keeping within all railroad clearances. The length of the boom is 28 ft., which enables it to be shipped anywhere on a 40-ft. car.

The crane is equipped to handle with equal facility, hook, bucket or magnet. The maximum capacity is seven tons at 12 ft. radius; or it will handle a ½- or ¾-cubic yard bucket with the boom extended to 28 ft. radius; or a 36-in. electromagnet handling a length of 130-lb. rail, weighing 1,430 lb., at the maximum radius. The wheels of the car are spaced 6 ft. 6 in. on centers, thus giving a wide base for stability. The boom measures 28 ft. 0 in., center to center, thus providing long enough reach to unload rails from a car in front or in back of the crane car, on the same or an adjacent track.

Power is furnished by a four-cylinder, 5-in. by 6½-in., heavy-duty gasoline motor, with high tension magneto. This motor is geared directly to the hoisting, swinging and traveling gears. It is operated by one man only. A generating set, belt-connected to the engine, furnishes current for a 36-in. electro magnet. This device is valuable in handling magnetic materials such as rails, switches, frogs, truck side frames, wheels, etc. Bucket handling drums are also furnished on the machine. A ¾-cubic yard bucket will hold on an average one-half ton of coal, and at a rate of two trips per minute, the machine will handle about 30 tons of coal an hour. As an emergency locomotive coaler, this crane can therefore be used to advantage. At the maximum radius, that is, 30 ft. from the center of the machine, the crane can handle 4,400 lb.

A separate shaft with two niggerheads, is supplied on the front of the crane. These are useful in pulling cars and dragging in loads to a position where they can be handled on the boom. The novel feature of this crane is its movability, both over a division and on its own car. Moreover, being gasoline motor driven, it is always ready for service without any preliminary firing, nor is any trouble encountered from bad weather or lack of ready coal supply.

Orton & Steinbrenner Gasoline Motor-Operated Crane Coaling a Locomotive

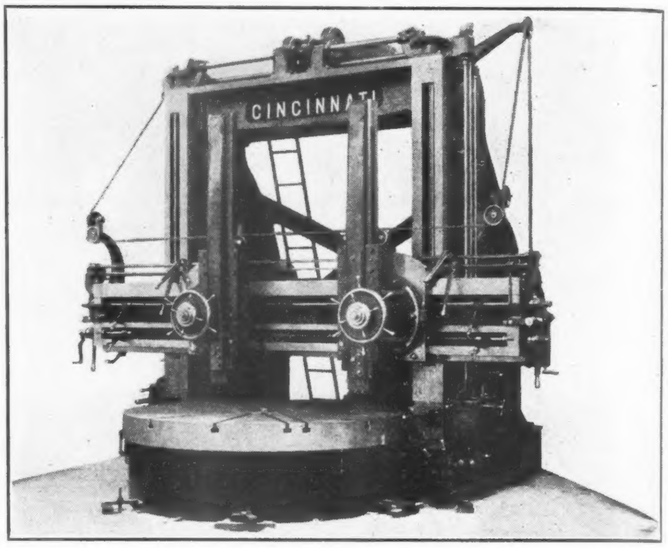
New Eight-Foot Massive Boring Mill

A SPECIAL 8-ft. massive boring mill with features of the design differing from the ordinary mill, has recently been placed on the market by the Cincinnati Planer Company, Cincinnati, Ohio. The table is driven by a bevel gear. The pinion that meshes with this gear, which is belted to the table, is supported on both sides and is a separate unit from the drive gear box. The upper spindle bearing is adjustable to compensate for wear.

When used with a variable speed motor, the drive gear box has four speeds. It has nine speeds when used with a constant speed motor. All the gears are of steel and the shafts are made of high carbon steel bearing in bronze bushings. The motor is mounted on top of the gear box and is geared down to the drive shaft. Speed change levers for operating the table changes have been placed directly at the operator's side which makes the machine easy to operate and facilitates faster production.

The housings, which are higher than those ordinarily used, are bolted, dowelled and tongued to the extension and tied together on top by a heavy box arch. This is done in order to eliminate all vibration. X-braces are also used to assist in firmly holding the housings. The heads are of special design, as can be seen in the illustration. The handle wheels are equipped with hand feed and lock, which can be operated to feed and lock without exertion. The rams are made extra long and the steel racks are bolted to them to allow for easy replacement. The feed and rapid traverse are controlled from the side of the head so that when using the head in the center of the table the control levers are within reach of the operator. Sensitive handles are also provided to permit the tools to be easily set.

The feeds are obtained through an all-steel gear box that provides eight different feeds. This box has a vertical tumbler arrangement which automatically locks itself when placed in the correct position. Centralized control has been developed to such an extent that no matter what the operator is doing, he can reach any lever desired. The rail is raised



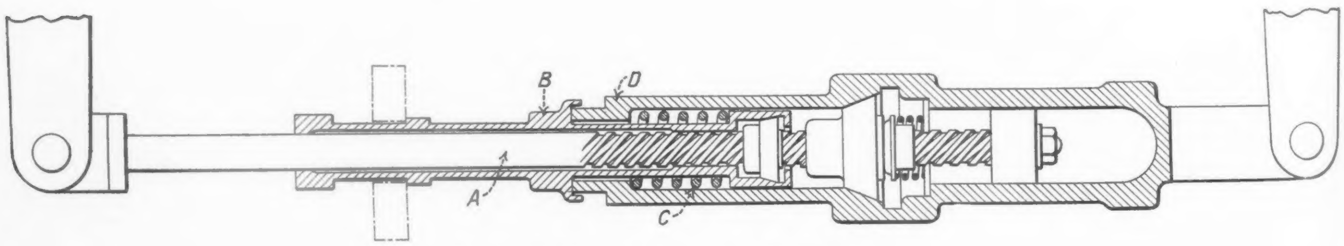
A Double Head Boring Mill of Massive Design

and lowered by an elevating device that has positive clutches, with the addition of a safety friction clutch. The rail is prevented from rising beyond its maximum height by a limit stop that automatically throws out the clutch.

The A. L. M. Slack Adjuster

A NEW type of slack adjuster has recently been developed and is now undergoing a trial on the Metropolitan Railway, Paris, France. This device is known as the A.L.M. slack adjuster. It has also been successfully used in Europe on street cars, automobiles, elevators and hoists.

With few exceptions, all slack adjusters now in practical use depend on a step-by-step action in the form of a ratchet or some equivalent, such as shims, and consequently do not take up the slack as soon as it is formed, but only after it has been developed to a certain degree. The A.L.M. type of slack adjuster differs from this type in that it takes up the slack immediately on the first application of the brake after this slack has developed. It also has the advantage of being entirely enclosed so that the main sleeve body can be filled with grease. This tends to prevent deterioration of the working parts.



Sectional View of A. L. M. Slack Adjuster

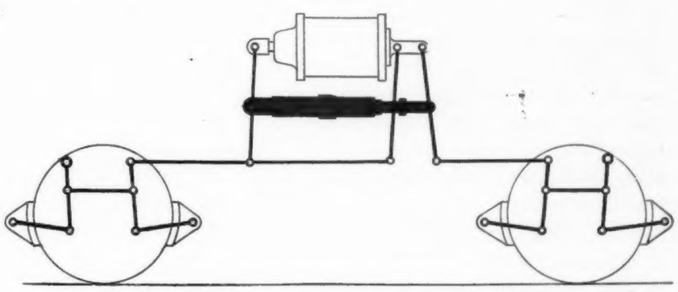
Referring to Fig. 2, the principal operating part consists of a high pitched screw *A* on which two nuts travel. The actual operating nut is provided with a conical outer surface, which corresponds to a conical seat in the main sleeve body *D*. Another nut is also provided with a conical surface on the outside which seats in a corresponding cone surface on the inside of the auxiliary sleeve *B*. This auxiliary sleeve slides inside the main sleeve and is held in position by means of a spring *C*. Both the main sleeve *D*, and the auxiliary sleeve *B*, are provided with a back stop, which engages the main and auxiliary nut, respectively, when either of these are moved by the action of the screw. The operating force is applied directly to the main sleeve. The brake lever is connected to the screw rod, through which the force is transmitted through the main sleeve, nut and screw to the brake rod.

The principle of the adjuster is based on the relative move-

ment of the brake rod and screw, which are directly connected through the brake rigging to a fixed point on the truck. If there were no wear, this movement would be constant and would correspond to the clearance between the brake shoes and wheels. As soon as wear has taken place, this relative movement will be increased. By arranging the stops on the auxiliary sleeve to allow for a movement corresponding to the normal brake shoe clearance, the auxiliary sleeve is prevented from following the movement of the screw as soon as it exceeds the normal clearance. The auxiliary sleeve is forced to move with the screw and main sleeve, thus the spring *C*, is gradually compressed. During this movement between the screw and the auxiliary sleeve, the auxiliary nut is released from its conical seat and moves up against the back stop. This prevents the nut from following the screw any further. On account of being free from its conical seat, it is at liberty to turn and move up the screw as long as the screw turns. When the brake is released again, the auxiliary nut immediately seats itself in the auxiliary sleeve and is thus prevented from turning back. Consequently the screw is locked in its new position and since the movement of the auxiliary sleeve is limited by the stop, the brake shoes cannot move away from the rims of the wheels any further than the normal clearance. In this manner the wear is taken up by the auxiliary nut.

This movement has not shortened the total length of the adjuster. When the auxiliary sleeve has stopped in its return movement, the main sleeve has still a certain distance to go before reaching the normal position of the main and auxiliary sleeves. An interposed spring consequently causes the main sleeve to continue its return movement, which releases the main nut from its seat in the main sleeve. It is thus required to travel up the screw just as far as the auxiliary nut was forced up the screw during the time the brakes were applied.

By dividing the slack-taking into two distinct steps, one between the brakes and the other between the wheels and the end of the adjuster to which the force is applied, it is possible to bring about the adjustment in infinitesimal steps, without the need for any external trip arrangement which usually requires a special design for each particular type of truck. G. S. Albanese, New York, has the United States patents on this device.

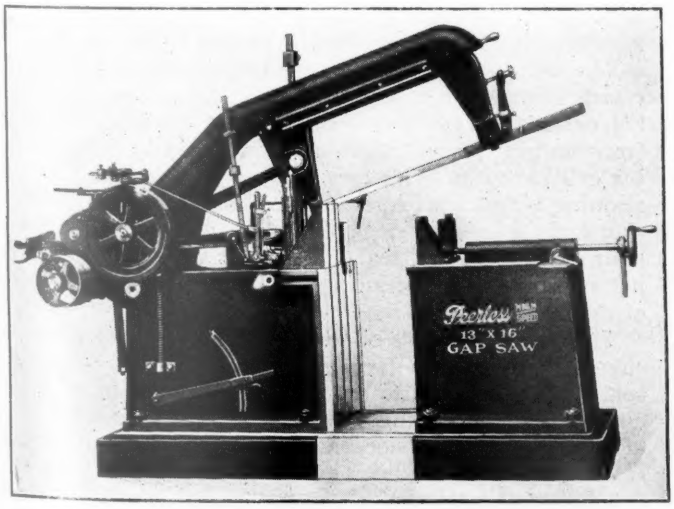


Arrangement of Brake Rigging Showing Application of Slack Adjuster

New Type of Power Hack Saw

A NEW type of power hack saw, known as a gap saw, has recently been announced by the Peerless Machine Company, Racine, Wis. When the gap is open, it has an excess work holding capacity 24 in. in height and 16 in. in width. When the gap is closed, the saw can be used for ordinary purposes.

The work can be clamped either to the finished vertical face on the bed, where four T-slots are provided for clamping purposes, or directly to the base, where three T-slots give ample clamping facilities. The base has a trough extending entirely around its perimeter, which carries the coolant back into a reservoir located in the rear of the base. At this point a geared rotary pump forces the coolant up into the distributing pipe. The finished pad which is opposite the gap and located on each side of the base, is for the convenience of the operator when locating work that is to be clamped directly to the base. The left-hand edge of the bed is also finished for purposes of convenience in measuring when the gap is open for holding large pieces.



Hack Saw with Gap for Large Holding Capacity

A piece of steel 16 in. by 26 in. can be cut in two by sawing through 13 in. and then meeting the cut by turning the piece half way around. This type of work is often encountered in a railroad shop or drop forge shop where hammered forgings, such as are machined up into crankshafts, are often blocked out prior to the machining operations required to produce finished dimensions.

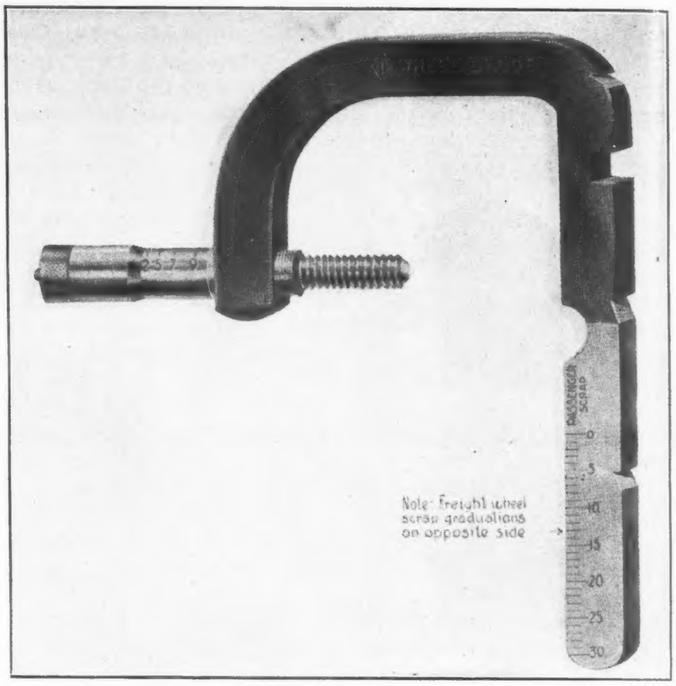
The head and feed mechanism is of substantial construction. The head lifts up on each return stroke and when the blade comes to the bottom of the cut, the feed is automatically disengaged. The head is then lifted up to its uppermost position through the usual arrangement of balance springs. The blade pressure or feed can also be varied at will by raising or lowering the ratchet lever on the side of the head shown in the illustration.

The machine shown in the illustration is equipped with the standard six-speed stroke mechanism, which is commonly used on Peerless high speed saws when the materials to be handled require different cutting speeds. Either this attachment or a two horsepower motor can be used with this machine. The general specifications are: Capacity of machine on ordinary work, 13 in. by 16 in.; capacity of gap work, 16 in. by 37 in.; length of blade, 14 in. to 24 in.; length of machine, 80 in.; width of machine, 30 in.; weight of machine, approximately 3,000 lb.; distance from the floor to the top of the base, 6 in.; distance from the floor to the top of the table, 30 in.; shipping weight, approximately 3,500 lb.; number of strokes per minute of the saw frame, 125.

Steel Wheel Gage with Micrometer Attachment

A STEEL wheel gage, known as the I-D type, especially designed to meet the demands for a service metal gage of permanent accuracy to a fine degree, has been placed on the market by the Universal Packing & Service Company, Chicago. This gage is especially suitable for wheel shops, lathe men and inspectors. It is similar in design to the A. R. A. type steel wheel gage described in the December, 1923 number of the *Railway Mechanical Engineer*. As shown in the illustration, micrometer readings are inscribed on the top of the micrometer screw for convenience in reading. The micrometer sleeve, holder and screw are finely machined with a polished finish. This screw has a special alloy tool steel ball point to eliminate any inaccuracies due to contact wear. The body is of drop-forged steel, lacquered black, except the graduated part, which is polished.

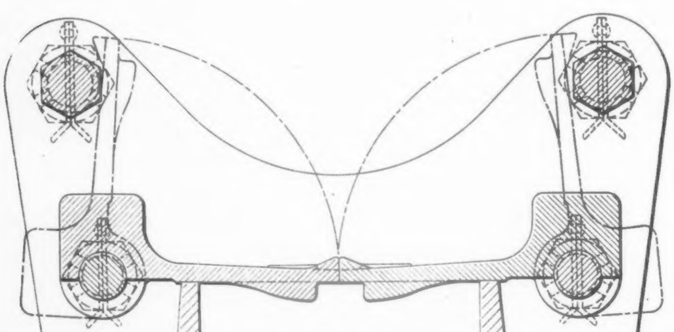
The method of using this gage is the same as that for the A. R. A. gage, except that the micrometer screw is used instead of the swinging finger. It provides a very accurate method of determining the tread thickness, the amount of material to be removed to restore the A. R. A. standard contour, the service metal remaining after the contour is restored, whether worn wheels are fit for further service or should be scrapped, the limit of depth and location of witness grooves in flanges, the limits of slid flat and shelled spots, vertical flanges, chipped rims, the limit of wear on journal collars, and a coupler gage.



The I-D Micrometer Wheel Gage

Automatic Exhaust Nozzle Cover

TO overcome carbonization in locomotive valve chambers and steam cylinders, the Detroit Lubricator Company, Detroit, Mich., has placed on the market the Detroit automatic exhaust nozzle covers. These covers are designed to provide a simple and inexpensive device which, without resort to drifting valves, will protect the cylinders and parts exposed to steam pressure and consequently increase the life of cylinders, valves, bushings, piston rings, rods and packing.



Sectional View of Exhaust Nozzle Cover

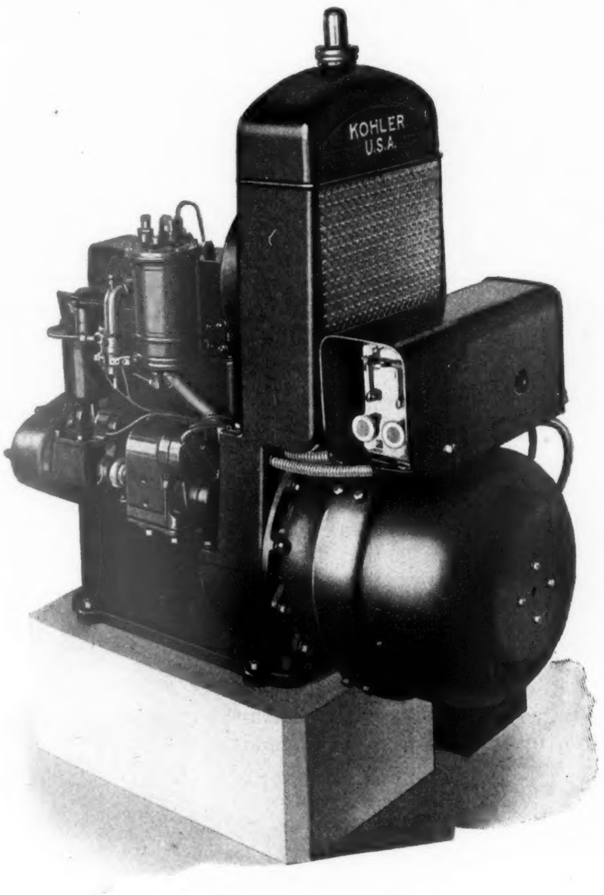
When steam is shut off and a locomotive is drifting, a partial vacuum is created by the movement of the pistons which acts to draw cinders and hot gases from the smokebox through the exhaust passages and into the valve chambers and steam cylinders. The heat burns the oil and destroys the lubrication on the walls while the cinders act as an abrasive to cut the packing and piston rings and produce carbonization which plugs up the passages. This is so generally recognized that engineers often drift with the throttle cracked open to destroy the vacuum when the locomotive is not fitted with special drifting valves.

The device consists of a pair of hinged clack valves or covers mounted in a suitable framework for attachment to the exhaust nozzle in the smokebox. These covers swing freely on hinge pins. When the engine is working the escaping exhaust steam holds the covers in an open position, thus allowing a free discharge. Immediately after the throttle is shut and the exhaust stops, the covers automatically close by their own weight and seal the nozzle against the entrance of hot smokebox gases and cinders to the valves and cylinders of the locomotive.

The covers are made of steel castings with their faces machined to fit the top faces of the nozzle tips. The hinge bearings are designed to prevent any accumulation of dirt or cinders from interfering with the free and automatic action of the covers. The side frames supporting the covers are steel castings arranged for mounting on the nozzle by bolts or studs. These frames carry the hinge bars and stops to prevent over-travel of the covers. In the majority of cases the framework is so designed that it can be attached by bolts or studs in the same location as the bolts for holding the tips onto the nozzles. As the design of exhaust nozzles and tips varies considerably on different locomotives, special patterns of covers and frames are furnished to suit the different requirements.

Car Lighting Plant of Unusual Design

A LIGHTING plant that has the unusual feature of automatic operation is being successfully used by several western railroads. This plant, with a 2,500-watt, 110-volt direct-current generator, independently driven, was installed in a gasoline motor coach for the Chicago & North Western, described in the October number of the *Railway Mechanical Engineer.* A rail motor car similarly equipped, but with a 1,500-watt generator, is in operation on the Santa Ana branch of the Union Pacific. The car used is a McKeen motor car, which weighs 70,000 lb. It is driven by a 200-hp. (S.A.E. rating) internal combustion engine burning kerosene and has a seating capacity of 72. It was lighted originally with gas. To provide a better headlight and more convenient lights for interior lighting and for markers, the small lighting plant was installed.



The Lighting Power Plant Complete

No auxiliary storage battery is required for lighting with these plants, which are made by the Kohler Company, Kohler, Wis. Turning on the first light causes the generating plant to start automatically. Turning off all the lights causes it to stop. It consists essentially of a 4-cylinder, 3½-hp. gasoline engine driving a 110-volt, 1,500-watt direct current generator. The overall dimensions of the power plant are 14 in. by 31½ in. by 36 in. high. The engine is water cooled and is of the valve-in-head type. The bore of the cylinders is two inches and the stroke is three inches. A high tension magneto is used for ignition. A small 24-volt storage battery, which is kept charged automatically, is used for starting.

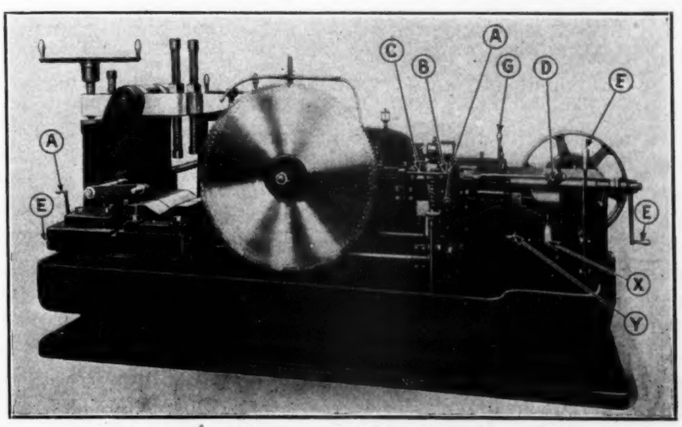
All circuits are controlled from switches on a panel in a metal cabinet in the operating department. When one of the lights on the circuit is turned on, the closing of the lighting circuit actuates a relay which operates the starting switch. Under light load the plant operates at a speed of about 850 r.p.m. When the load is increased, the plant automatically builds up its speed to take care of the load. The voltage remains practically constant at all loads and speeds. This is accomplished by an electrically operated throttling governor and special windings on the generator.

To provide for emergency, a 24-volt headlight lamp is carried in the car. If the 110-volt power should fail, the 110-volt headlight lamp would be replaced with the 24-volt lamp and the circuits are arranged so that the starting battery can be used to operate the headlight. The gas side lights have been left in the car for interior emergency light.

A New Metal Sawing Machine

THE Cochrane-Bly Company, Rochester, N. Y., has placed on the market a cold saw, having a capacity for cutting 13-in. round stock, 12 in. square, or 10-in. by 15-in. rectangular sections. The machine is driven by a friction clutch pulley, 24 in. in diameter by 9-in. face, and the drive shaft is equipped with ring oiling bearings. The pulley hub has an oil reservoir with a capacity for sufficient oil to last several months. The clutch is controlled by the levers *F* at either front or rear position. It has three cutting speeds, 30, 40 and 50 ft. per min. Changes are made by sliding a cone of gears on the driving shaft by means of a lever conveniently located on the outside of gear box as shown at *G*. All gears in the machine, except the worm gears, are made of steel, fully enclosed and run in a bath of oil. The miter gears on the drive shaft as well as the arbor gear and intermediate gear in the worm gear box, are of nickel steel and case hardened. The pinions meshing in these gears are of chrome-nickel steel and hardened. The worm gears are of phosphor-bronze. The driving worm is of hardened steel and is fitted with a heavy ball thrust bearing that runs in oil. This is an important feature as it tends to prolong the life of the bearing.

The bed of the machine is set in a deep pan, which catches the oil and chips. The oil drains into a generous reservoir to which a geared pump is connected. The bed is scraped to precision surface plates to create true surfaces to which the



Cold Saw Capable of Cutting 13-Inch Round Stock

saw carriage has been carefully fitted. The saw arbor is hardened and ground and fits into a solid bearing. There is no bolted joint in the carriage bearings to yield under cutting strains.

The feed screw is directly in line with the center of the saw arbor, and placed as close as possible to the saw blade. This brings the feed pressure as nearly as possible in line with the resistance of the saw. The nut on the feed screw is split and is adjustable endwise to take up all lost motion. Adjustable hardened steel nuts take up all lost motion between the screw and the gear box. The feed screw is driven by a worm, worm gear and compound spur gears. The tumbler *X* gives six changes, which are doubled by sliding gears *Y* that are in mesh with the gears on the worm shaft. The feed is started, stopped and reversed by the control lever *A* from either the front or back of the machine. A double pawl holds the clutch block in neutral position, engaged with the feed gear, or allows it to engage with the reverse gear, according to the position of the control lever. The pawls are lifted by means of a rack and pinion operated by the lever *A*. A movement of this lever to the left raises the feed pawl, tripping the machine into reverse, which automatically returns the saw carriage at a high speed to a point determined by the adjustable stop collar *B* on the trip rod *C*. The adjustable stop collar *D* lifts both pawls at the same time, automatically tripping the machine from feed to reverse. The control lever is moved to the right to release the reverse clutch and engage the feed clutch. The carriage can be adjusted to or from the work by the cranks *E* at either end of the machine.

The vise has double clamping screws to hold the stock at two points. These screws are hand operated. A vise with clamps operated by means of compressed air can also be furnished. A stock feeding device for pulling the bar through the vise by simply turning a crank is included with the regular equipment. The stock support carriage is moved by means of a chain, sprocket and crank, which is back geared to the sprocket shaft. One operator can easily adjust a 12-in. by 12-in. billet in the vise. The top of the yoke on the carriage is hinged and can be opened to facilitate placing the bar in the machine.

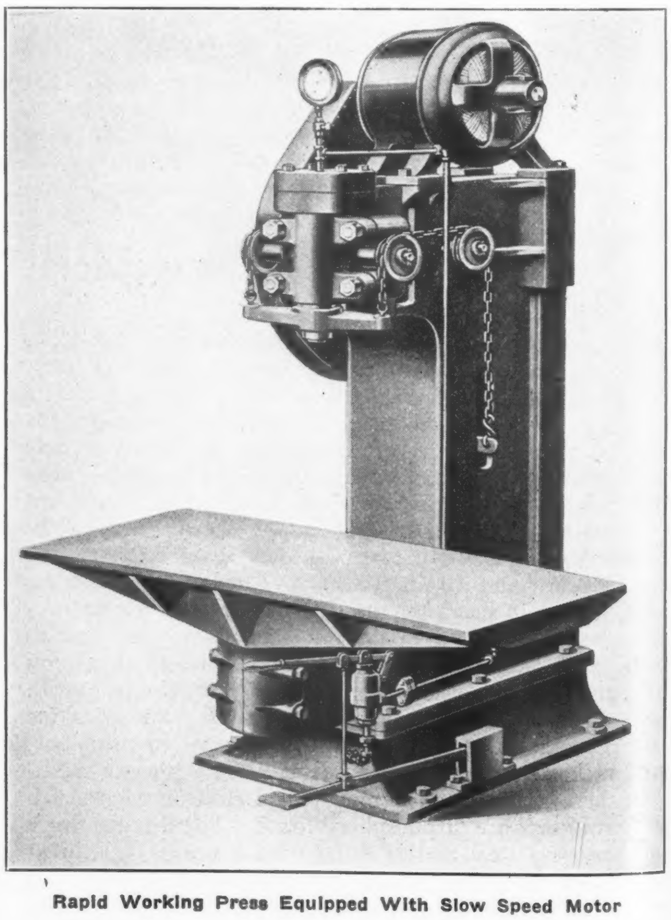
The machine has the following general specifications. Capacity: Round bars, 13 in.; square bars, 12 in.; I-beams, 18 in.; rectangular sections, 8 in. by 15 in. Capacity of 60 deg. fixtures for multiple cutting: ½-in. bars, 229; 1-in. bars, 53; 1½-in. bars, 26; 2-in. bars, 19; 2½-in. bars, 13; 3-in. bars, 8; 4-in. bars, 4; 5-in. bars, 4. The saw blade has a diameter and thickness of 37 in. and 9/32 in. respectively, and is mounted on a 6-in. mandrel with 9-in. collars. Eleven feed changes from ½ to 2½ in. per min. are provided. The work table is 24 in. high and has an area of 30 in. by 27½ in. The speed of the driving shaft is 300 r.p.m. A 20-hp., 860-900 r.p.m. motor is required. The belt and motor-driven machines occupy a floor space of 71 in. by 129 in. and 89 in. by 129 in., respectively, and have a net weight of 12,600 lb. and a crated weight of 13,200 lb.

Hydraulic Straightening Press

The Watson-Stillman Company, New York, has recently brought out a rapid working hydraulic press for use in bending, straightening or forcing operations. It is designed to handle any work requiring pressure up to the full capacity of the press. It is a self-contained unit, being driven by a motor and requiring no auxiliary water or power supply. The operation is fast and under absolute control of the operator both as to speed and pressure. Movement of the ram is controlled by means of a valve operated either by a hand or foot lever. The pump is arranged so that the movement of the press ram through the idle portion of its stroke is very rapid and the change from low to high pressure for the actual straightening operation is effected automatically. A feature of importance is that the whole table can be removed. This leaves an open jaw forcing press that can be utilized in any kind of shop work, such as mandrel forcing, broaching, force fitting and assembling and many other kinds of work common to railroad shops.

The whole unit is built in a substantial manner, with all the working parts under detachable dirt proof guards. The frame is made of a steel casting with a copper-lined cylinder, bolted and keyed to the frame. The ram is made of high carbon steel. The base is of cast iron and serves as a reservoir for the pump. The pump body is of bronze and the plungers are of hardened tool steel packed with hemp under bronze glands. All packings are easily accessible. The pump valves are made of Monel metal and are of the metallic seated type. The ram is equipped with a positive stop to prevent over-stroke. This is an important feature considering the rapidity with which the press can be operated and provides an essential factor of safety.

Hydraulic pressure is used only for the pressure or downward motion of the ram; the return is accomplished by a counterweight inside of the frame. The illustration shows the press equipped with a slow speed motor with single reduction gearing to the pump shaft. A high speed motor can also be used, with compound gearing to the crankshaft.

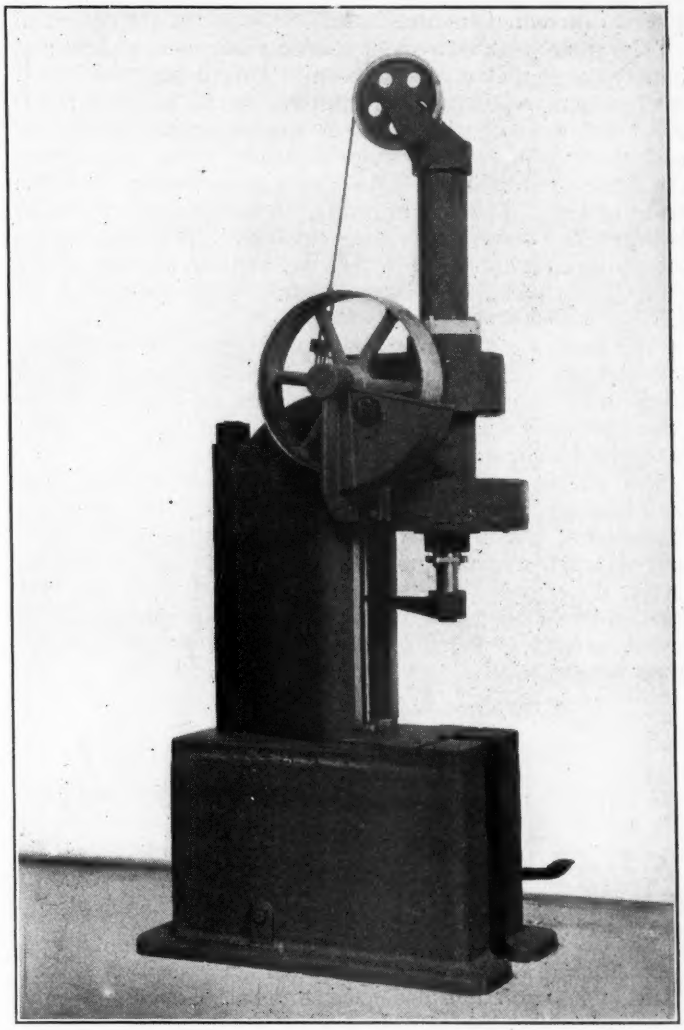


Rapid Working Press Equipped With Slow Speed Motor

New Flexible Power Press

A FLEXIBLE power press that combines speed of operation and adaptability to various conditions of operation is now available for railroad shop equipment. This machine can be readily adapted to such work as straightening shafts of all descriptions, bending, forming, assembling gears on shafts, pressing in bushings and bearings, burnishing holes to size and heading rivets cold. It operates under pressures varying from one pound to 20 tons and can be used for any job without danger of damage to the machine or tool. As shown in the illustration, the base of the machine is of heavy box type construction and down the front of the base, under the center of the ram, is a slot which permits flanged shafts, etc., to be placed on the work table. The top of the base forms the table. It also supports the column, which in turn supports a ram case heavily ribbed to withstand torsional strains. Heavy tie bolts fasten the table, column and ram case together in one solid unit. The ram is made of .50 per cent manganese chrome alloy steel, having a tensile strength of 135,000 lb. It has a quadruple thread of coarse pitch, which insures ample strength of the tooth section under all conditions. The ram is also provided with two opposed splined keyways for drive in rotation. The nose of the ram has a hardened steel thrust cap and also a special nose piece is provided so that a variety of form tools can be used on the end of the ram. The rotation of the ram is obtained by a steel worm driving a phosphor-bronze worm gear. The entire drive is enclosed in a grease case, insuring good lubrication.

These presses are made in two sizes with a maximum pressure of 8 tons and 20 tons respectively. Both sizes are built practically to the same working dimensions. The maximum distance from the nose of the ram to the table is 20 in., the stroke of the ram is 18 in., and the height from the top of the table to the floor, 30 in. The ram travel for the 8-ton press is 155 in. per min. with a ram speed of 52 in. The shipping weight is 3,300 lb. The ram travel for the 20-ton press is 128 in. per min. with a speed of 32 in. Its shipping weight is 5,500 lb. These presses are built by the Fox Machine Company, Jackson, Mich.



Fox Flexible Power Press

Two New Elwell-Parker Trucks

TWO trucks designed for utility work around railroad shops and stores departments have been recently placed on the market by the Elwell-Parker Electric Company, Cleveland, Ohio. One of these trucks is an electric chisel truck designed to pick up objects set close to the floor and the other is a portable crane for handling the ordinary kinds of lifting work usually found around a railroad shop. The electric chisel truck carries the load ahead of the front axle on a platform or forks that can be lowered to touch the floor. The forks can be stopped at any desired height between the upper and lower limits, and may be so shaped at the outer ends as to be inserted beneath a bundle, box, casting or any irregular shaped piece weighing up to 2,500 lb.

Electric Portable Crane for Railroad Shops

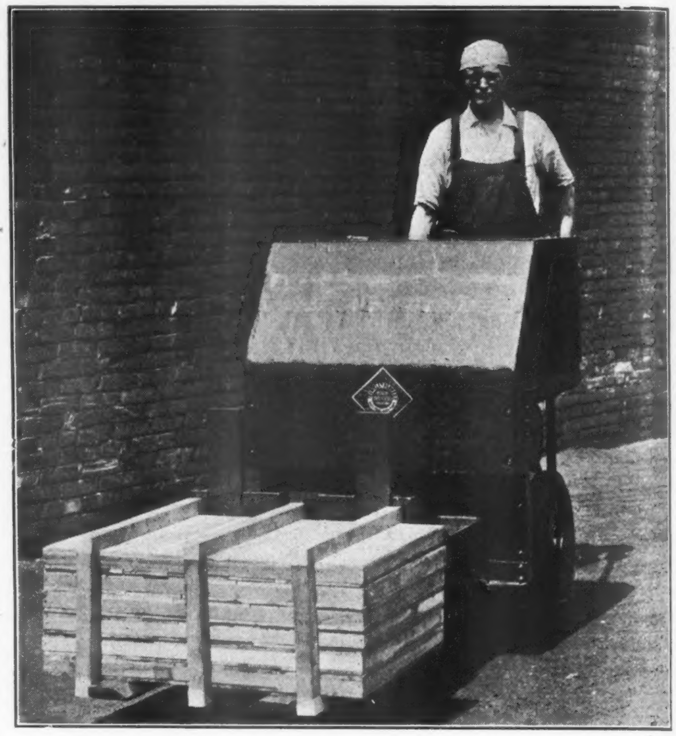
The length of the forks depends upon the weight carried, which is dependent upon the allowable loading of the front axle. The load handled balances an equal weight of the truck back of the front axle. This arrangement throws most of the weight on the front wheels. A special heavy axle with large, wide-spread roller bearings carries dual 10-in. by 3-in. rubber tired wheels. Both the front and rear wheels are used in steering. The knuckles are located close to the center of the tires. This assures easy steering and avoids any kick-back at the steering handle when the tires strike floor obstructions. The raising mechanism consists of a separate motor with worm gear reduction attached to a movable platen supported on the truck frame by means of three rocking links. This mechanism is simple in construction and is assembled as

a unit. The power or propelling unit in this truck consists of a heavy-duty motor and controller direct connected through a flexible coupling to a worm and wheel with a bevel pinion differential running in oil.

The crane truck consists of a lifting unit, power plant and battery counterbalancing the boom. This is supported on a steel column set in a base, anchored to an all-steel frame fitted with axles of wide gage. A separate controller operates each motor. Where the service demands, a motor to revolve the crane is provided. This also receives power from the same battery. The forward axle, or that nearest the hook, is heavy, and serves as a rolling outrigger. The front wheels are equipped with 15-in. by 3½-in., and the driving wheels with 22-in. by 4½-in. all-rubber tires. The truck steers on all four wheels and is easy to handle.

The hoist mechanism consists of a single motor driving two separate drums through worm gearing running in oil. Each drum is fitted with a ⅜-in. plow steel cable, one to raise and lower the boom, the other to handle the hook. Each is operated independently.

For stacking stores, the crane is provided with a boom somewhat shorter than that furnished for use in locomotive shops where it is necessary to reach up over the boiler. The unit is moved from point to point by means of an electric motor, direct connected through worm gearing on the axle beneath the battery and just back of the crane column. This motor, as well as the hoist motor, receives power from the same battery.



Oil Reservoir Is Attached to the Smokebox Above the Distributor

Bubb Locomotive Cylinder Lubricator

A POSITIVE and reliable lubricator for locomotive steam cylinders is being introduced by the Sheafe Engineering Company, Chicago. This device, known as the Bubb automatic lubricator, is extremely simple and is constructed along entirely new lines. It is entirely automatic in its operation, has fixed adjustment, feeds oil only when the locomotive is working and requires no attention aside from that necessary for draining and filling. Separate lubricators are furnished for the right and left-hand cylinders.

Oil Reservoir Is Attached to the Smokebox Above the Distributor

The lubricator includes an oil reservoir and a distributor together with accompanying parts and the necessary piping. The oil reservoir or lubricator body is attached to the smokebox at a convenient height. It is equipped with a filling plug, a drain cock and a mixer. This mixer, marked *A* in one of the illustrations, is screwed into the bottom of the lubricator body. It is hollow, has one small hole through the top and one or more small holes on the side near the top which determine the rate of speed and is provided with a pipe connection at the bottom. The head is ⅝ in. diameter, the section being somewhat reduced below this point. The mixer cap, *B*, which screws over the mixer, *A*, has one or more small openings near the bottom for the admission of oil to the small mixing chambers between *A* and *B*, as shown on the next page.

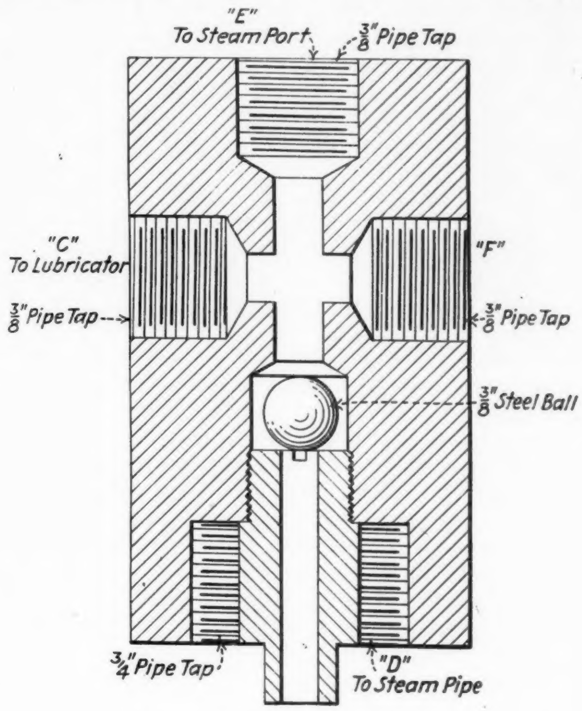
A ⅜-in. O.D. copper pipe connects the mixer to the side opening *C* of the distributor. The opening *D* in the bottom of the distributor is connected direct to the steam pipe, while the opening *E* on the top is usually piped to one of the steam ports leading to the locomotive cylinder. The other side opening *F* is usually plugged. The distributor contains a ⅜-in. steel ball, seating upward and kept in place by a hollow retaining plug.

While the throttle valve is open, there is always steam in the steam pipe and underneath the ball valve. At each stroke of the piston steam is also admitted through the main valve to the pipe connecting the top of the distributor to the steam port. At this time the pressure above and below the ball are equalized and the ball is off from its seat as shown. Steam then flows to the mixing chamber between *A* and *B* and emulsifies the oil therein. When the piston valve shuts off the steam, the pressure above the ball drops and it then seats upward. Emulsified oil now flows down the pipe from the mixer and collects above the ball, while fresh oil flows into the mixer chamber ready for the next admission of steam. When the flow of steam is reversed, the ball again drops and allows the accumulated emulsified oil to flow down into the main steam pipe. The lubricator starts and stops with the locomotive. The oil being completely emulsi-

fied promptly mixes with the steam. As the only moving part is a small steel ball, there is nothing to get out of working order.

Oil Reservoir with Mixer

The only way in which the rate of feed can be altered is to change the number or size of holes in the mixer or to put a choke plug in the outlet of the mixer. The latter is usually resorted to when the lubricator is used on switch engines.



Section Through the Distributor

This lubricator has been in successful operation on a number of locomotives for several months in both freight and passenger service. As shown, in the photograph of the front end of the locomotive, the oil reservoir is simply attached to the smokebox above the distributer. This location makes the device easily accessible at all times. This factor is important from the standpoint of the amount of time required in preparing the engine.

Unique Tractor Drive Increases Work Output

AN internal gear drive for industrial tractors has been perfected by the Mercury Manufacturing Company, Chicago, and after three years of experimental operation, a new model—the Type H tractor—has been placed on the market in which this drive mechanism has been incorporated.

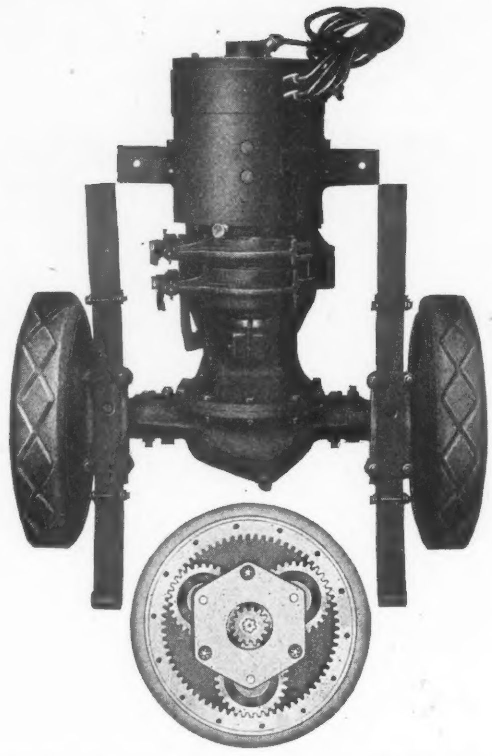
The most important advantage claimed by the manufacturer, on the basis of elaborate tests, is an increase of 25 to 35 per cent in mechanical efficiency, compared with the Type L tractor of this company, a worm-drive model. These tests showed, for example that at a 200-lb. draw-bar pull, the new model was developing an efficiency, indicated by speed and current consumption, 23 per cent greater than the Type L; at a 600-lb. draw-bar pull, 28 per cent; at 800-lb. draw-bar pull, 40 per cent, etc. This increase in efficiency means an ability to run longer on one charge, to handle heavier loads during the same length of time, or to reduce the amount of the charge without reducing the reserve capacity of the batteries.

According to reports from the manufacturer five tractors of the new internal gear drive which have been in experimental service for the last two years, have demonstrated high

The Type-H Mercury Tractor

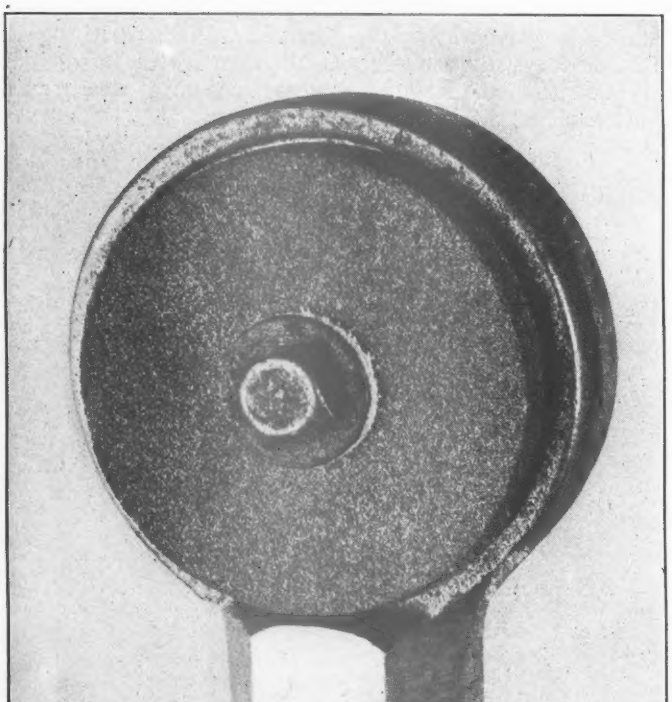
efficiency in maintenance as well as in operation. Thus far it has been unnecessary to replace any parts of the drive mechanism. The salient features of the new drive are the balanced arrangement of the driving gears within the wheels; the method used to position these gears in relation to one another; and the provision for an oil and dust tight enclosure for every moving part. The power plant comprising the motor, motor hanger, rear axle housing, rear wheels, rear springs and all driving gears, is assembled in a single unit which may be readily detached from the frame. The sequence of operation in this drive unit is as follows: The motor, joined to a pinion through a self-alining spring coupler, drives a bevel gear contained in the axle housing. This gear in turn drives the axle pinions to each rear wheel. The axle pinions transmit the power through three idler gears to a large ring gear mounted on the inner circumference of the drive wheels.

The motor is a high-speed, series-wound automotive type, its characteristics being adapted to the gear drive and battery assemblies used. The coupling between the motor and the driving pinion comprises four coil springs which cushion the initial starting torque, thereby allowing greater freedom of alinement, and eliminating much of the shock attending the operation of the machine. The frame, controller, safety features, wheel arrangement, etc., follow the lines which have been developed and used in the earlier designs of this company's equipment. The tractor has been used to very good advantage around freight houses for handling L.C.L. freight, storehouses and railroad shops.



The Power Plant and a View of the Internal Gear

Flue Gas Filter for CO_2 Equipment



Pyro-Porus Filter for Eliminating Fouling and Corrosive Gases

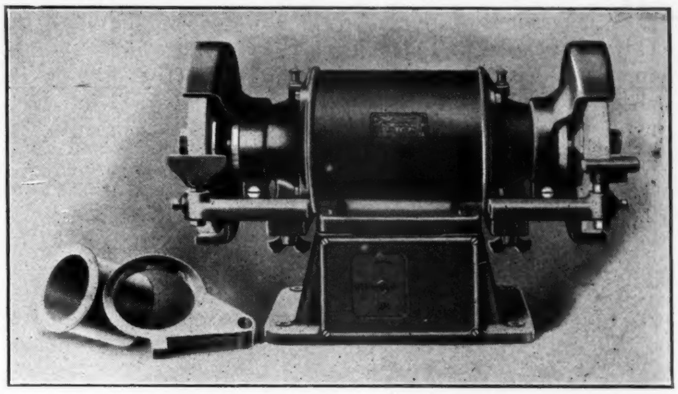
THE Uehling Instrument Company, Paterson, N. J., has designed an attachment for the purpose of filter-flue gas for its CO_2 equipment. The filter consists of two porous disks held in a special casting by means of a bolt. The disks seat on asbestos gaskets and possess the necessary refractory qualities to resist the high temperatures ordinarily encountered. Aside from the reduction of attention required when using this improved method of filtration, there is the added advantage that a smaller size of sampling line can be employed because its entire cross-sectional area is effective when it is kept clean.

The filter, known as the Pyro-porus, is threaded for both a ¼-in. and a ¾-in. pipe. The preferred arrangement, however, is to withdraw the gas sample through an inner ¼-in. pipe and to utilize a ¾-in. outer pipe as a means for securely holding the filter in position. The majority of CO_2 recorders draw the flue gas through an open-ended pipe and filter through cotton waste or fabric. This necessitates more or less blowing out of the gas line with compressed air and frequent renewal of the filtering material. With the new method of filtration, the soot builds up on the filter and does not enter the pores to any extent, in fact this deposit of soot in itself is a good filtering medium. It is said that these disks are so effective that a piece of cotton placed in the gas sampling line will remain white indefinitely. Actual performance tests of these filters are also said to show that after continuous service for many months at a time, it is not necessary to have the sampling line blown out or to have the disks on the filter replaced, and no increased resistance to the gas flow is offered. The filter is placed on the inlet end of the gas sampling line and is inserted into the flue or last pass of the furnace. It is a big improvement over the old method of filtration and should result in a far more desirable gas sample.

Bench Grinder for Small Tools

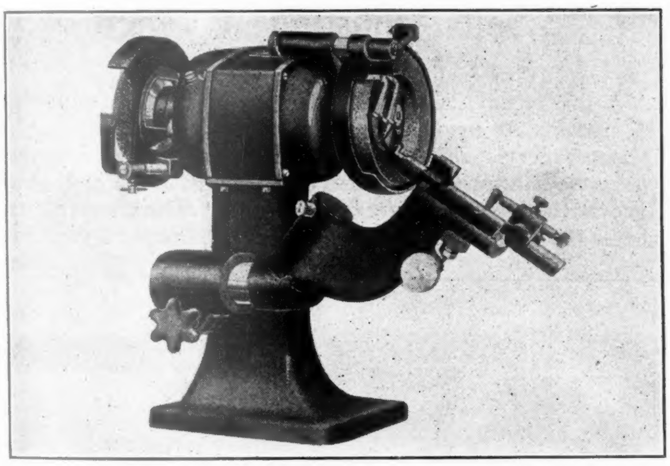
A BENCH grinder for grinding small tools is being manufactured by the Hisey-Wolf Machine Company, Cincinnati, Ohio. It is made in ½- and 1-hp. sizes. The grinding wheels are mounted directly on the spindle of the motor, which is furnished for either direct or alternating current. Ball bearings are used, mounted in the motor end caps in close proximity to the grinding wheels. All bearings are completely enclosed and are provided with heavy felt washers on each side of the bearing housing.

The motor is started by pressing a button located in front of the machine. The switch mechanism is in the base of the machine, to which easy access can be obtained by removing the cover plate. With the direct current motor, the ½-hp. machine runs at a speed of 3,000 r.p.m.; the 1-hp. machine at 2,100 r.p.m. The alternating current motor operates at a speed of 3,400 r.p.m. for the ½-hp. and 1,750 r.p.m. for the 1-hp. size. The grinder is provided with adjustable tool rests, detachable water pot and tool tray. It is equipped with steel wheel guards built to the standard dimensions and specifications recommended by the American Engineering Standards Committee. Coned shaped end heads and liberal wheel spacing provides liberal working space around the grinding wheels for two operators.



Hisey-Wolf Two-Wheel Bench Grinder

Bench-Type Twist Drill Grinder



A Bench Grinder for Twist Drills From No. 52 to 1¾ in. in Diameter

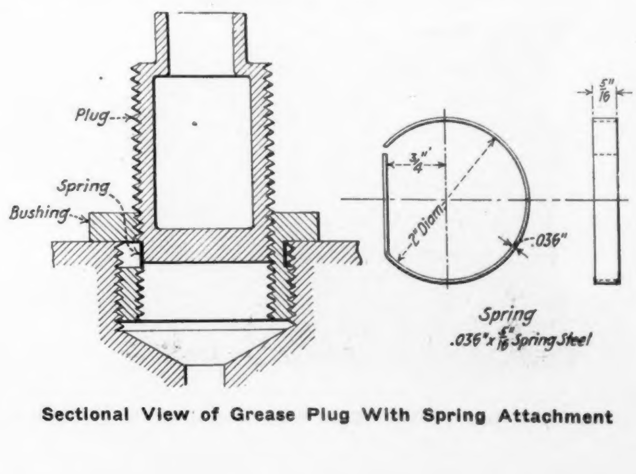
THE bench-type twist drill grinder illustrated is an interesting new development of the Gallmeyer & Livingston Company, Grand Rapids, Mich., successor to the Grand Rapids Grinding Machine Company. The grinder is driven by a self-contained motor, enabling it to be placed in any position in the shop toolroom where most convenient.

In the basic principles of design and operation it conforms to other Grand Rapids twist drill grinders. It has a diamond truing device and the diamond is furnished as part of the standard equipment for dressing the wheel. The holder is automatically placed in the right relationship with the grinding wheel so that it is close enough to grind the drills accurately and at the same time, the stop makes it impossible to bump the front of the holder into the grinding wheel. The machine illustrated is the A-7-T type with a capacity for drills from No. 52 to ¾-in. It is also made with a drill holder having a capacity of from ⅛-in. to 1½-in. drills, in which case it is designated style B-7-T.

Device to Prevent Loss of Grease Plugs

AN attachment to prevent the loss of grease plugs and bushings has recently been patented by Frank L. Fisher, Milwaukee, Wis. The principal part of the device is a spring placed so that when the grease plug is screwed into the side rod it comes in contact with a flat surface on the side of the plug. This spring prevents any vibration between the plug and the threads of the side rod bushing, which are locked together. As seen in the illustration, the spring is expanded by the insertion of the plug, against the inside threads of the side rod, causing a binding action between the rod and the bushing. This prevents the bushings from rattling out.

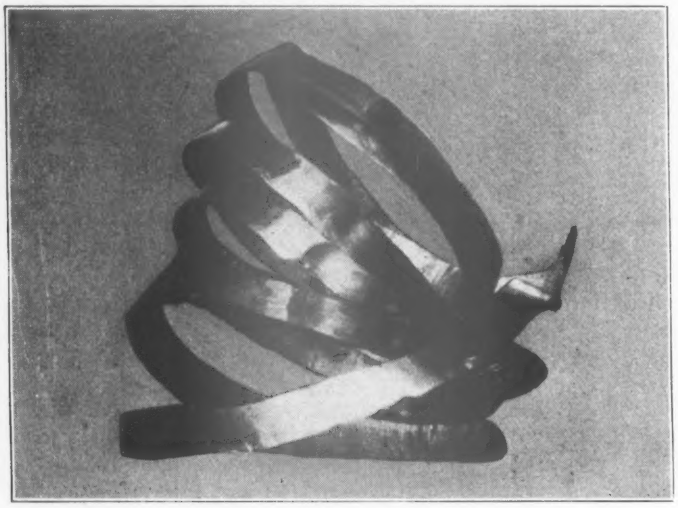
The spring is made of .036-in. by 5/16-in. spring steel. It is adaptable to different size grease plugs, as it is not essential that the diameter of 2 in. be maintained. The inventor states that the cost of the device should be from one to two cents, as the plug and bushing will be cast so as to permit the use of this attachment. Such being the case, this type of grease plug should cost approximately the same as an ordinary grease plug casting.



Sectional View of Grease Plug With Spring Attachment

Long Air Hammer Chip

AN unusual example of air hammer cutting power and smoothnes of operation is afforded by the long steel chip illustrated. This chip is 1/16 in. thick and 112 in. long, having been cut from a locomotive firebox side sheet by a No. C Thor chipping hammer with 3-in. stroke, made by the Independent Pneumatic Tool Company, Chicago.

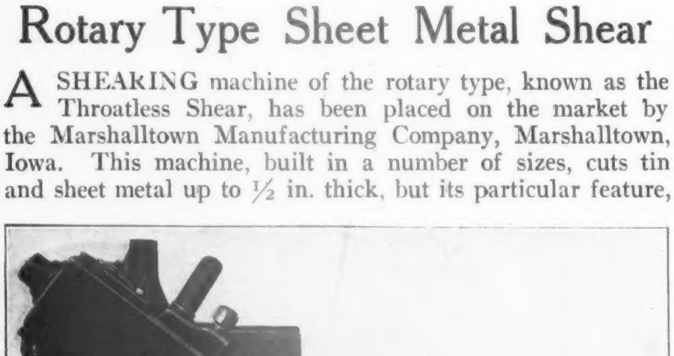


Air Hammer Chip 112 Inches Long, Cut from Locomotive Firebox Side Sheet By Thor Chipping Hammer

The air hammer in question had been in practically constant service for four years, and this long chip therefore shows both the durability of the hammer and the uniform strokes and accurate hammer control, without which boiler-makers cannot do a good job in trimming firebox sheets.

Rotary Type Sheet Metal Shear

A SHEARING machine of the rotary type, known as the Throatless Shear, has been placed on the market by the Marshalltown Manufacturing Company, Marshalltown, Iowa. This machine, built in a number of sizes, cuts tin and sheet metal up to ½ in. thick, but its particular feature,



Throatless Rotary Shear Cuts Sheet Metal Up to ½-In. Thick

as may be inferred from the name, is ability to cut sheets of any size, no matter how large. The machine is adapted for cutting in and out curves and complete circles, also for straight splitting. Circles as small as 20 in. in diameter can be cut.

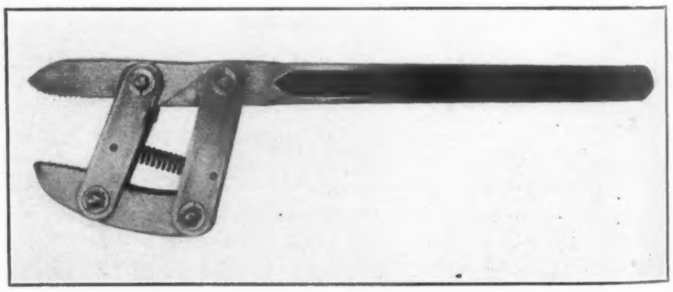
The head of the machine as well as most of the parts are made of cast steel. They are strongly built, designed with a large factor of safety, and it is said that not one has ever sprung or broken in operation. The cutters are set almost perpendicular, and are made of special tool steel 1⅛ in. thick and 10 in. in diameter, tempered. One of the cutters is knurled and driven which makes the shear self feeding.

The machine can be provided with either belt or motor drive, in the former case a friction clutch pulley being furnished as illustrated. With motor drive a friction clutch gear enables the operator to stop the shear with the motor still running. The speed of the pulley is 270 r. p. m., and sheets are cut at the rate of 6 ft. per min. The floor space required for the machine is 2 ft. 8 in. by 4 ft. 2 in., the distance from the floor to the cutters is 42 in. When motor driven, a 5-hp. motor running at 1,750 r. p. m. is required. The net weight is 4,600 lb.

This machine is adapted for use in locomotive boiler shops and tin shops, but should prove especially valuable in steel car shops where large and often irregular-shaped sheets have to be cut to replace those which are worn out in service or damaged in wrecks.

Self-Adjusting Wrench

A NEW wrench, known as the "Roberts" type, which does away with the usual hand screwing adjustment to make it fit an object, has been put on the market by the Greater Service Electric Company, Newark, N. J. Using only one hand with the wrench, it is simply necessary to place it over the object and it grips instantly. The wrench is said never to slip—the harder it is pulled the stronger it grips, and



New Wrench with Quick Adjustment Feature

at any angle. It also works with a new ratchet action which makes it easy to use in tight places.

The wrench is drop forged from high speed carbon steel. In its present 12-in. size, this wrench will handle any shape article from small nuts to one-in. pipe.

THE CHICAGO, ROCK ISLAND & PACIFIC has put into effect a plan whereby an employee entering the mechanical forces will be given personal instruction concerning his duties and the work which he will do. Under the plan each new apprentice entering the shop forces is examined to determine his special qualifications for certain work and is given instruction by a mechanic until he learns the general principles. This instruction is followed by technical training for special work to which he is finally assigned. Classes are now being conducted at Silvis, Ill., and similar classes are being organized at other points. The instruction is designed to develop a higher grade of mechanic and to remove the difficulty which now exists when an employee is placed in a position and left to work out his own salvation without proper instruction.

GENERAL NEWS

It is reported that the turbo-condensing locomotive invented by M. Ljungstrom is now running on regular express traffic between Stockholm and Hallsberg.

It is reported that a number of engineers of the Canadian National Railways are going to Europe to investigate the operating conditions under which Diesel oil-burning locomotives are used there.

According to George McCormick, general superintendent of motive power of the Southern Pacific, a number of Atlantic type locomotives have been equipped with boosters, feedwater heaters and other efficiency and economic appliances, at the Sacramento general shops. One of these locomotives was No. 3025. This engine was used at the exposition in San Francisco in 1915 to supply steam for the colored lighting effects. These newly equipped locomotives are making through runs of 471 miles. In test runs it was shown that they can travel from Los Angeles to San Luis Obispo, Cal., on a single tank of water, making intermediate stops unnecessary. The increased power permits smooth starting in trains from stations without the necessity of having to take up the slack in the train.

Anthracite Shipments in November

Shipments of anthracite for the month of November, as reported to the Anthracite Bureau of Information, Philadelphia, amounted to 5,828,754 gross tons, as compared with 6,564,526 gross tons in October, a decrease of 735,772 tons, or 11 per cent. The average daily shipment for the time the collieries were in operation during the month of November exceeded that for the month of October. Comparing November shipments of this year with the corresponding month in 1921, the latest normal year, an increase of 514,740 tons is shown, or 9.7 per cent.

New Directors for the A. R. A.

Directors of the American Railway Association for the term ending in November, 1926, have been elected as follows: Canadian Territory, Sir Henry W. Thornton, Canadian National; Eastern Territory, W. W. Atterbury, Pennsylvania, and E. E. Loomis, Lehigh Valley; New England Territory, E. J. Pearson, N. Y., N. H. & H.; Southern Territory, N. D. Maher, Norfolk & Western; Western Territory, Hale Holden, C. B. & Q., and W. B. Storey, A. T. & S. F. Messrs. Samuel Rea, Ralph Budd and C. E. Schaff were elected members of the committee on nominations for the term expiring in November, 1925.

Big Shop Improvement Program Carried Forward by Denver & Rio Grande Western

During the course of the year the Denver & Rio Grande Western has carried forward a large shop improvement program involving approximately $3,000,000. Improvements were made to shops at various points on the system, the location, estimated total expenditures and per cent completed estimated up to the end of the year being as follows: Burnham, Colo., $886,000, 28 per cent completed; Salida, Colo., $342,000, 65 per cent completed; Grand Junction, Colo., $242,000, 70 per cent completed; Alamosa, Colo., $158,400, 75 per cent completed and Salt Lake, Utah, $1,167,000, 35 per cent completed.

Locomotive Development Shown in Great Northern Exhibit

Two locomotives, which illustrate graphically the developments in motive power which have been made during the last half century, are being sent over the line of the Great Northern for exhibition purposes at various points. They are the "William Crooks No. 1," which was the first engine brought into the state of Minnesota and which arrived on a river barge in 1861, and passenger locomotive No. 2500, which represents the latest type for passenger service. In connection with the exhibition, the Great Northern is offering a prize of $10 for the best amateur photograph of the two engines. More than 500 snapshots were taken at Grand Forks, N. D., Devils Lake and Minot, the points which have already been visited.

Wage Statistics for September

The Interstate Commerce Commission's summary of the reports of Class I steam roads for September indicates that this is the first month, since January, 1923, in which the employment has failed to show an increase over the returns for the preceding month. The carriers reported 1,945,917 employees, a decrease of 27,588 or 1.4 per cent as compared with the number reported for August, 1923, and an increase of 237,326 or 13.9 per cent over the returns for September, 1922. This large increase in employment is due partly to the increased business of the year 1923 and partly to the fact that in September of last year the shopmen's strike was still effective on many roads. In the transportation (train and engine service) group the employment was greater in September, 1923, than in any month reported under the present classification of employees, which became effective July 1, 1921.

November Locomotive Shipments

The Department of Commerce has prepared the following table showing November shipments of locomotives from the principal manufacturing plants, based on reports received from the individual establishments:

	Nov. 1923	Oct. 1923	Nov. 1922	Eleven months' total Jan. to Nov. 1923	Eleven months' total Jan. to Nov. 1922
Shipments:					
Domestic	270	295	144	2,680	862
Foreign	29	15	15	180	202
Total	299	310	159	2,860	1,064
Unfilled orders (end of month)					
Domestic	656	915	1,501	....	....
Foreign	35	62	118	....	....
Total	691	977	1,619	....	....

Labor Board Decisions

C. & A. ORDERED TO NEGOTIATE WITH A. F. OF L. UNIONS.—The Shop Employees' Association of the Chicago & Alton, which was formed by the shop workers subsequent to the shopmen's strike in 1922, has been ruled out by the Labor Board as the authorized representative of the shopmen on the road, and the Chicago & Alton has been ordered to negotiate changes in the shopcrafts agreement now in effect with the committee of the shop employees represented by System Federation No. 29 of the Railway Employees' Department, American Federation of Labor. Of the 2,700 mechanical department employees in the service of the Alton there are approximately 15 now in service who participated in the formation of the association last year, according to testimony. In its decision, the board ordered that, if a question arises relative to the right of the Federated Shop Crafts to represent the shop employees on the Alton, arrangements shall be made to take a secret ballot to determine the wishes of such employees definitely. —*Decision No. 2024.*

ELECTION OF EMPLOYEE REPRESENTATIVES UNDER LABOR BOARD ORDERS.—In two addenda to previous decisions, the Railroad Labor Board has ordered that in case one or more of the interested parties in an election of employee representatives ordered by the board should decline to participate therein, the employees are nevertheless entitled to an election. In one instance, the Gulf Coast Lines

and the Houston Belt & Terminal refused to participate in an election ordered by the board in Decision No. 1838 on petition of the Railway Employees' Department of the American Federation of Labor. The Great Northern also declined to participate in an election ordered by Decision No. 1947, also on petition of the Railway Employees' Department of the American Federation of Labor. In both instances, the board has ordered that if the representatives of the road decline to assist in holding the election, the representatives of the employees who desire to participate in the election shall arrange the details of the ballot, giving due notice to any other organizations comprising employees of this class of the date of election and taking other precautions for a fair election.—*Addendum No.* 1 *to Decision No.* 1838 *and Addendum No.* 1 *to Decision No.* 1947.

Court Decisions

CONSTRUCTION OF BOILER SAFETY APPLIANCE ACT.—In a fireman's action for injuries from a fall caused by the shaker bar slipping off the lever, the Texas Court of Civil Appeals holds that under the Boiler Safety Appliance Act the railway company is under the absolute duty to keep the shaker bar in proper condition and safe to operate, so that it may be used by the employee without unnecessary peril to life or limb. No rule has been promulgated by the Interstate Commerce Commission as to how tight the shaker bar must fit over the end of the lever attached to the grates, so that the railroad must exercise its common-law duty in selecting the appliance.—Davis v. Callen (Tex. Civ. App.), 250 S. W. 305.

DEDUCTION FROM WAGES FOR ABSENCE ON ELECTION DAY.—The Illinois Supreme Court holds that the act of June 22, 1891, Section 25, as amended (Hurd's Rev. St. 1917, C. 46, Section 312), in so far as it forbids the employer to make deduction from an employee's wages because of his absence for two hours on election day for voting, deprives employers of their money and property without due process of law, and denies them the equal protection of the laws in violation of the state and federal constitutions, and is not a valid exercise of the police power as tending to promote the health, safety or morals of employees, or the public comfort, welfare, safety, or morals.—People v. Chicago, M. & St. P., 206 Ill. 486, 138 N. E. 155.

FEDERAL ASH PAN ACT.—The Texas Court of Civil Appeals hold that in the requirement in the federal Ash Pan Act of ash pans which can be dumped or cleaned without the necessity of the employee going under the locomotive, the words "go under" are to be used in their popular sense, and a violation is not proved by showing that in closing the pan the employee's body would be partially under the running board or the extension of the floor of the cab. Otherwise appliances would be required extending several feet beyond the rails, rendering them dangerous.—Fort Worth & D. C. v. Smithers (Tex. Civ. App.), 249 S. W. 286.

Movement Started to Co-ordinate Study of Fuel Economy by the Railroads

Co-operative action on the part of all the railways looking toward a reduction in the annual fuel bill was anticipated at a joint meeting of the American Railway Association's Committee on Fuel Conservation, of which F. H. Hammill, assistant general manager, Chicago & North Western, is chairman, and a committee of the International Railway Fuel Association, of which Eugene McAuliffe, special representative, Union Pacific, is the chairman.

The most important action taken at this meeting, which was held at Chicago on December 19, related to the establishment of some central agency for consolidating a large part of the test work and fuel research relating to fuel economy that is now being individually undertaken by railways throughout the country. The plan recommended for adoption by the executives of the American Railway Association would provide for the employment of a research director with necessary staff for the consideration of problems relating to railway fuel operating economies. The plan contemplates an immediate canvass of the present facilities and the measure of co-operation that may be obtained from the various existing laboratories now equipped and in position to carry on research work. It would also provide for the dissemination of the available information pertaining to fuel and related operating economies as developed in tests heretofore made by individual railways and educational institutions.

The railways have already achieved remarkable economies in fuel use as a result of the tests conducted by many railroads during recent years, but there is yet a vast amount of research work to be accomplished toward the attainment of maximum fuel economy. The several locomotive testing plants now available to the railways cannot be fully utilized until some such co-operative plan as now proposed is put into effect. The continuous use of one or more locomotive testing plants under these conditions would not only afford more authoritative information as to the value of certain devices and practices in relation to fuel economy than is now obtainable, but would obviate a large duplication of effort on the part of various railways that are now separately engaged in an investigation of the same devices and methods.

The Interstate Commerce Commission does not now require the railways to use a uniform ratio in equating the quantities of fuel oil and coal burned as reported in the monthly operating statistics for Class I railways, so that at the present time there are wide variations in these reports to be accounted for. At the meeting on December 19 consideration was given to the steps that have already been taken by the International Railway Fuel Association and the American Railway Association's committee on Fuel Conservation toward the determination of a satisfactory ratio for this purpose and the presentation of this matter before the Bureau of Statistics of the Interstate Commerce Commission with the recommendation that this ratio be made compulsory for all railways reporting quantities of oil consumed in terms of pounds of coal.

MEETINGS AND CONVENTIONS

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL. V. R. Hawthorne, 431 South Dearborn St., Chicago.
DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.
DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—W. C. Stephenson, Atlantic Coast Line, Rocky Mount, N. C.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 W. Forty-third St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Next meeting January 8. A paper on Some Recent Notable Locomotives, also some performance figures on three-cylinder locomotives, will be presented by James Partington, estimating engineer, American Locomotive Company.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, 605 Federal Reserve Bank Building, St. Louis, Mo. Meetings, first Tuesday in month at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchison, 6000 Michigan Ave., Chicago, Ill.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash St., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting January 8. Paper on Stores and Supplies will be presented by U. K. Hall, general storekeeper, Union Pacific.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal.

RAILWAY CLUB OF GREENVILLE.—G. Charles Hoey, 27 Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meetings fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Next meeting January 11. A paper on Locomotives will be presented by Grafton Greenough, Baldwin Locomotive Works.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The Bucyrus Company, South Milwaukee, Wis., is preparing plans for an addition to its plant at Evansville, Ind.

The Orton & Steinbrenner Company, Chicago, has completed an addition to its works at Huntington, Ind., which will double the output of the company.

Dwight E. Robinson has been appointed manager of railway sales department for Toch Brothers, Inc., 110 East Forty-second street, New York City.

The Bethlehem Shipbuilding Corp., Ltd., Union plant has removed its city sales offices to 1000 Matson building, 215 Market street, San Francisco, Cal.

J. G. Aye, general foreman of the Southern Pacific at Fresno, Cal., has been appointed a service engineer of the Franklin Railway Supply Company, Inc., New York.

The O'Fallon Railroad Supply Company, St. Louis, Mo., has been appointed representative in the southwestern territory for the Burden Iron Company Railroad and Steamship Division, St. Louis.

Willard A. Smith, editor and publisher of the Railway Review, Chicago, died at Evanston, Ill., on November 29, at the age of 74, failing by only a few months to complete a half-century as publisher of that paper.

N. P. Farrar has been appointed district manager of the Pawling & Harnischfeger Company, Milwaukee, Wis. Mr. Farrar's headquarters are at 605 Stephen-Girard building, Philadelphia, Pa., and 50 Church street, New York City.

John D. Ristine, sales manager of the railroad motor coach division of the Service Motor Company, with headquarters at Wabash, Ind., has resigned to become assistant vice-president of the Mason Coal Company, with headquarters at Chicago.

D. B. Wright has resigned as railroad representative with Paul Dickinson, Inc., with headquarters in Chicago, to become manager of the railroad sales department of the B. F. Nelson Manufacturing Company, Minneapolis, Minn., manufacturers of roofing, insulating and waterproofing materials.

The Q & C Company, New York, announces that it has acquired the exclusive United States rights for the manufacture and sale of the Unlimited travel type roller side bearing, under any and all patents granted to E. A. Laughlin, Oregon, Ill., and previously sold by the Standard Coupler Company.

Hendricks Commercial Register, New York, heretofore owned by the Kelly Publishing Company of London, England, will be taken over on January 1, 1924, by MacRae's Blue Book Company, Chicago. Both books will continue as at present.

The H. B. Wilson Company, St. Louis, Mo., composed of H. B. Wilson and J. M. Shea, who have represented the Mahr Manufacturing Company in that city for the last two years, has recently been given additional territory extending along lines of various railroads out of St. Louis and including Kansas City.

J. R. Sexton, railway sales manager of the H. H. Robertson Company, with headquarters at Chicago, has also been appointed district manager, with the same headquarters, succeeding H. F. Hackedorn, deceased. Mr. Sexton will continue as manager of railway sales in conjunction with his work as district manager.

LeGrand Parish, who has been president of the Lima Locomotive Works, Inc., since 1918, has resigned to devote his entire attention to the American Arch Company, Inc., of which he is also president. He will, however, remain on the executive committee of the former company. J. S. Coffin has been elected president of the Lima Locomotive Works to succeed Mr. Parish.

The Pfaudler Company, Rochester, N. Y., makers of glass-lined steel milk tank cars, has appointed H. A. Stuart, manager of the newly created milk transportation division, with headquarters at Rochester, N. Y. This company has inaugurated a system of leasing so that the dairyman is not obliged to purchase the glass-lined milk tank car used in transporting milk in bulk, but may lease it for a period of time at a fixed rental, and at the end of this period either purchase the car outright or renew the lease.

The National Malleable Castings Company, Cleveland, Ohio, will change its corporate name in the near future to the National Malleable & Steel Castings Company. The corporation now has shops in operation at Cleveland, Ohio; Sharon, Pa.; Toledo, Ohio; Indianapolis, Ind.; East St. Louis, Ill.; Chicago, and Melrose Park, near Chicago. There will be no change in the officers or personnel of the corporation and the change in name is to be made to cover the scope of its steel castings production.

The Stewart Manufacturing Corporation, Chicago, has taken over the properties of the Jerome-Edwards Metallic Packing Company, Chicago, and George C. Jerome, president of the Jerome-Edwards Metallic Packing Company, has been appointed manager of the railroad department of the Stewart Manufacturing Company, with headquarters at Chicago. He was born on November 10, 1865, at Port Huron, Mich., and entered the metallic packing business in 1884 with the C. C. Jerome Company, which was organized by his father. He held numerous positions in the plant and was traveling representative for the company when he took over the control of the business. In 1903 he organized the Jerome & Elliott Company at Chicago and in 1913 purchased the interest of Mr. Elliott and organized the Jerome-Edwards Metallic Packing Company at Chicago.

G. C. Jerome

James H. Waterbury, for twelve years resident manager of Pratt & Lambert, Inc., Buffalo, N. Y., died on December 8, at the Buffalo General Hospital, following a brief illness. Mr. Waterbury was born in Brooklyn, N. Y., on January 1, 1881. After completing school in his native city, he attended a private school near Philadelphia, Pa. He began his business career in the New York office of Pratt & Lambert, Inc., in January, 1898. Two years later he went to Buffalo as assistant resident manager and since 1911 served as resident manager.

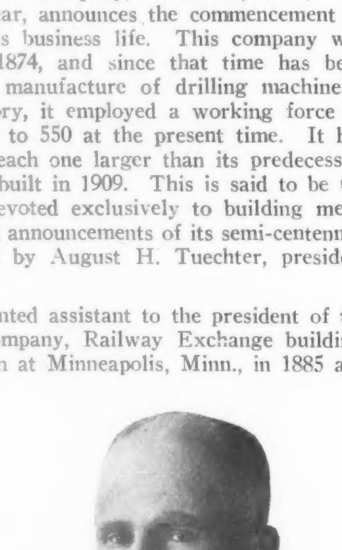
A. E. Ostrander, formerly in charge of engineering for the American Car & Foundry Company, who has been on a leave of absence since early in 1922, has returned to work and on December 17 was transferred to the sales organization with the title of assistant vice-president and with headquarters at New York City. Mr. Ostrander is in charge of the miscellaneous sales department and will also handle special sales duties as may be assigned. He was born in New Haven, Conn., and began his career with the New York, New Haven & Hartford, serving in various capacities in the operating and mechanical departments of that road. He later entered the service of Cornelius Vanderbilt in New York City, and from there went with the mechanical department of the Standard Steel Car Company at Pittsburgh. In 1903 he came to the New York office of the American Car & Foundry Company, serving successively as draftsman, estimator, chief estimator and assistant mechanical engineer. In 1915 he was appointed mechanical engineer and in 1918 general mechanical engineer, with headquarters in New York.

A. E. Ostrander

The Compagnie Belgo-Mandchoue de Commerce, 39 Kitaiskaja, Harbin, Manchuria, is a large contractor for the Chinese Eastern Railway, and buys various materials for the road. It wants the names of American firms that can supply the following: Spare parts for railway cars and locomotives; tools for use on railways, hand tools for metal working, also wood working tools, and other miscellaneous tools; shovels; axes; iron pipes; copper pipes; valve cocks; pumps; bolts, nuts, etc.; merchant iron, sheet iron, corrugated iron; tool steel; builders' hardware, wire nails, also iron nails; electrical appliances; paints and varnish; railway scales and railway supplies, also a number of other products.

The Cincinnati-Bickford Tool Company, Cincinnati, Ohio, with the beginning of the New Year, announces the commencement of the second half century of its business life. This company was incorporated on January 2, 1874, and since that time has been continuously engaged in the manufacture of drilling machinery. At the beginning of its history, it employed a working force of ten men. This has increased to 550 at the present time. It has in turn occupied four shops, each one larger than its predecessor, before the present plant was built in 1909. This is said to be the largest plant in the world devoted exclusively to building metal drilling machinery. Engraved announcements of its semi-centennial anniversary have been issued by August H. Tuechter, president of the company.

L. G. Plant has been appointed assistant to the president of the National Boiler Washing Company, Railway Exchange building, Chicago. Mr. Plant was born at Minneapolis, Minn., in 1885 and was first employed by the Baldwin Locomotive Works as a special apprentice and as a boilermaker apprentice on the Southern Railway. He studied at the University of Virginia and at Stevens Institute of Technology from which he received the degree of mechanical engineer in 1909. He then entered the employ of the Southern Pacific lines as a student of operation. Later he was employed as a mechanical engineer on a subsidiary of the Southern Pacific in charge of equipping the railroad for the use of fuel oil, and in 1913 was appointed superintendent of fuel service for the Southern Pacific Lines in Texas and Louisiana. In 1914 he was appointed fuel engineer on the Seaboard Air Line, which position he held until 1918. Shortly after the Division of Finance and Purchases of the Railroad Administration was organized at Washington, he was made progress engineer and chief clerk to the manager of the procurement section. In March, 1920, Mr. Plant joined the staff of the *Railway Mechanical Engineer* as an associate editor and a year later he went to the Railway Review in the same capacity. On December 30, 1922, he was appointed to the position of editor of the Railway Review. Mr. Plant has given particular attention to locomotive fuel and terminal problems and is the author of a number of articles and papers on these and other subjects.


L. G. Plant

Joseph F. Farrell, general manager of the Nathan Manufacturing Company for the past seven years, has been appointed vice-president; Alfred Nathan, Jr., secretary, has been elected treasurer, and Edwin F. Wallace has been elected secretary, all with headquarters at New York. Mr. Farrell entered railroad service in December, 1889, as a clerk on the Lake Shore & Michigan Southern. In September, 1906, he became chief clerk in the purchasing department of the Lake Erie & Western. In April, 1907, he was appointed assistant purchasing agent of the Michigan Central, and in September, 1907, became purchasing agent of that railroad. Mr. Farrell left the railroad field in July, 1912, to become vice-president of the American Materials Company, and in August, 1916, was appointed general manager of the Nathan Manufacturing Company.

Stephen C. Mason, secretary and director of the McConway & Torley Company, Pittsburgh, Pa., who served as president of the National Association of Manufacturers from 1918 to 1921, died on December 12 at his home in Pittsburgh from dilation of the heart. He had been ill for about six weeks. Mr. Mason was born in Fairlee, Vt., on February 1, 1861, and was educated in the common school and at Orford (N. H.) Academy and Newbury (Vt.) Seminary. He began his business career with the Connecticut & Passumpsic Railroad at Lyndeville, Vt., in 1880, serving with that company until 1888, when he resigned to go with the Interstate Commerce Commission at Washington, with which he served in various capacities until as assistant statistician he was in charge of the compilation and publication of the commission's statistics of railways in the United States. He gave up this position in 1896 to go to the McConway & Torley Company, where he served in various capacities and at the time of his death was secretary and director of that company. He was vice-president from Pennsylvania of the National Association of Manufacturers and then became president. He was also vice-president of the Steel Founders' Society of America, executive member of the Railway Business Association, also a member of the National Industrial Conference Board, member of the Chamber of Commerce of Pittsburgh and chairman of the finance committee of the Railway Club of Pittsburgh.


S. C. Mason

Frank C. Pickard has been elected vice-president of the Talmage Manufacturing Company, Cleveland, Ohio. Mr. Pickard was born on September 20, 1880, at Trenton, Mich., and entered railroad service as a messenger boy at the age of 14 on the Chicago, Hammond & Western at Hammond, Ind. At Bedford, Ind., on the Southern Indiana, he finished two years' apprenticeship at the machinist trade and entered the road service as a fireman and engineman. After leaving that service, he worked on various western railroads until 1905, when he entered the service of the Pere Marquette as a machinist and served as machine foreman, erecting foreman and shop superintendent. In 1908 he left the Pere Marquette to go as master mechanic on the Mississippi Central and in 1909 went to the Cincinnati, Hamilton & Dayton as master mechanic of the Indianapolis and Springfield division. During this period he was elected president of the International Railway General Foremen's Association and served for two terms. In 1911 Mr. Pickard was appointed master mechanic of the Saginaw district of the Pere Marquette and in 1912 entered the service of the Delaware, Lackawanna & Western as division master mechanic at Buffalo, N. Y. He was a contributor to railroad clubs and technical journals on mechanical subjects. During this time he served as president of the Central Railway Club and as a member of the executive committee of the Niagara Frontier Car Inspection Association. He resigned from the Delaware, Lackawanna & Western on December 1 to enter his present connection.


F. C. Pickard

TRADE PUBLICATIONS

AIR HOISTS.—Hanna patented air hoists and I-beam trolleys are fully described and illustrated in catalog No. 14, recently issued by the Hanna Engineering Works, Chicago.

ELECTRIC MOTORS.—"Electric Motors—How to Choose and Use Them," is the title of an interesting 32-page brochure recently issued by the Reliance Electric & Engineering Company, Cleveland, Ohio.

THREADING MACHINES.—The Geometric Tool Company, New Haven, Conn., has issued a 38-page illustrated brochure describing its Geometric threading machines, which are built in ½ in., ¾ in. and 1½ in. sizes.

CRANES.—Two new booklets, Nos. N-1346 and N-1387 (O-2057), illustrating and describing power house and other bucket handling cranes have been issued by the Whiting Corporation, Harvey, Ill.

BRASS GOODS.—Hose couplings, nozzles, clamps, valves, sill cocks and other brass accessories are described and illustrated in a neatly arranged catalogue recently issued by the Schlangen Brothers Company, Chicago.

ENGINE TENDER CONNECTIONS.—Bulletin No. 42, containing interesting statistics and test data, has recently been issued by the Barco Manufacturing Company, Chicago, describing its 3V type engine tender connections for steam, air, oil and water.

WROUGHT PIPE.—Seven reports covering unusual accidents, which show the great strength, uniformity and durability of National pipe, are contained in a booklet entitled, "Seven Wonders of Wrought Pipe," recently issued by the National Pipe Company, Pittsburgh, Pa.

INSULATION.—A 63-page illustrated booklet covering the subject of insulation of high temperature apparatus, such as is used by almost all industries—steam lines and equipment, ovens, furnaces, stills, cookers, kettles, sterilizers, etc.—and describing the peculiar qualities of Nonpareil high pressure covering, blocks and cement for high temperature insulation, has recently been issued by the Armstrong Cork & Insulation Company, Pittsburgh, Pa.

MICARTA.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued a 24-page illustrated booklet entitled, "A Material of Endless Possibilities," containing information about Micarta and the many uses to which it has been put and indicating the possibilities for other applications. Some of the products for which Micarta is already used are bushings, gears, gaskets, handles, insulators, pinions, pulleys, washers, etc.

STOKERS.—The Westinghouse new model multiple retort underfeed stoker is described and fully illustrated in a 14-page brochure recently issued by the Westinghouse Electric & Manufacturing Company, Philadelphia, Pa. It shows the results they have obtained in this line after thirty-five years' experience in the design and manufacture of combustion equipment. The stoker is built in all types and sizes to meet the specifications for industrial and central station requirements.

GEARS AND SPEED TRANSFORMERS.—William Ganschow, president of the William Ganschow Company, Chicago, is editing a new handbook on gears and speed transformers, which will be combined with the forthcoming Ganschow general catalog No. 100. The purpose of the handbook is to afford the user of gears and speed transformers easy access to formulæ and data regarding their design and use. It contains much data that is usually found only in general engineering handbooks. Aside from the formulæ and data pertinent to gears and speed transformers, it also contains much information that is useful in the designing of machinery to which they may be applied. There are also tables showing strength and weight of materials, trigonometric functions, geometric formulæ, decimal equivalents, wire and sheet metal gages, and standard screw threads, together with other miscellaneous information. Being combined with the general Ganschow catalog, it brings together in one volume all the information necessary for the design or specifications of gears or gearing for any purpose, and shows complete lists for all products, which are regularly manufactured by the Ganschow Company.

EQUIPMENT AND SHOPS

Locomotive Orders

THE TEXAS-MEXICAN has ordered from the Baldwin Locomotive Works a 4-6-0 type locomotive.

THE MOBILE & OHIO has ordered two 4-6-2 type locomotives from the Baldwin Locomotive Works.

THE ALABAMA & VICKSBURG has ordered three 4-6-2 type locomotives from the Baldwin Locomotive Works.

THE SAN JOAQUIN & EASTERN has ordered one Prairie type locomotive from the Baldwin Locomotive Works.

THE ARGENTINE STATE RAILWAY has ordered five 2-8-2 type locomotives from the Baldwin Locomotive Works.

THE TOLEDO, ANGOLA & WESTERN has ordered one 2-8-2 type locomotive from the American Locomotive Company.

THE SOUTH MANCHURIAN RAILWAY has ordered five 2-8-2 type locomotives from the American Locomotive Company.

THE DELAWARE, LACKAWANNA & WESTERN has ordered 10 2-8-2 type, 10 4-6-2 type and 5 4-8-2 type locomotives from the American Locomotive Company. The 2-8-2 type will have 28 by 32 in. cylinders and a total weight in working order of 357,000 lb.; the 4-6-2 type will have 25 by 28 in. cylinders and a total weight in working order of 297,000 lb.; the 4-8-2 type will have 28 by 30 in. cylinders and a total weight in working order of 370,000 lb.

Freight Car Orders

THE CHESAPEAKE & OHIO will build 25 caboose cars in its own shops.

THE PHILADELPHIA & READING will build 20 caboose cars in its own shops.

THE CHICAGO & ALTON has ordered 250 box cars from the Pullman Company.

THE SEABOARD AIR LINE has ordered 25 caboose cars from the Magor Car Corporation.

THE LOUISVILLE, HENDERSON & ST. LOUIS has ordered 3 baggage and mail cars, 2 coaches and 2 smoking cars from the American Car & Foundry Company.

THE GULF COAST LINES has ordered 4 coaches, 2 partition coaches, 2 baggage and 2 baggage and mail cars from the American Car & Foundry Company.

THE BALTIMORE & OHIO has ordered 500 hopper cars from the Pressed Steel Car Company and 500 box cars from the American Car & Foundry Company, the railroad reserving the right to furnish some of the trucks.

THE PACIFIC FRUIT EXPRESS COMPANY is placing orders for the building of 3,057 new refrigerator cars for delivery prior to the peak of the 1924 season. It is estimated the cost of the new cars will be about $10,000,000.

THE ALABAMA & VICKSBURG has ordered 100 gondola cars of 50 tons' capacity from the American Car & Foundry Company, and 200 box cars of 40 tons' capacity and 100 flat cars of 50 tons' capacity from the Chickasaw Shipbuilding Company.

THE SOUTHERN RAILWAY, reported in the December *Railway Mechanical Engineer* as having ordered 1,000 box cars from the American Car & Foundry Company, has increased the order 2,000 cars, making a total of 3,000 cars ordered from the American Car & Foundry Company.

Machinery and Tools

THE CHICAGO, BURLINGTON & QUINCY has placed an order for 2 car wheel borers.

THE NEW YORK, NEW HAVEN & HARTFORD has placed an order for a car wheel borer.

THE DENVER & RIO GRANDE WESTERN has ordered a 90-in. wheel quartering machine.

THE NEW YORK CENTRAL has placed an order for a 14-in. engine lathe and for a 42-in. journal lathe.

THE NORTHWESTERN PACIFIC has ordered a 15-ton electric traveling crane from the Whiting Corporation.

THE PERE MARQUETTE has ordered eight jib cranes of from one to six tons' capacity from the Whiting Corporation.

THE WABASH has ordered one 22-ton 8-wheel standard gage locomotive crane from the Orton & Steinbrenner Company, Chicago.

Shops and Terminals

WABASH.—This company plans the construction of a 20-stall brick roundhouse at St. Thomas, Ont.

KANSAS CITY SOUTHERN.—This company will construct a two-story office building at its shops at Pittsburg, Kan.

NEW YORK, CHICAGO & ST. LOUIS.—This company will construct a one-story machine shop at Conneaut, Ohio, at a cost of $40,000.

CENTRAL OF GEORGIA.—This company plans the reconstruction of a portion of its car shops at Savannah, Ga., recently destroyed by fire with a loss reported to be $500,000.

SOUTHERN.—This company has authorized Dwight P. Robinson & Company, Inc., to design and construct extensive additions to its shops at Birmingham, Ala. The work includes locomotive repair shops, boiler and smith shop, car repair sheds, mill shop, power plant and other buildings.

CHESAPEAKE & OHIO.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of water treating plants at Moorehead, Ky., Olive Hill, Hurricane, W. Va., and Sproul. The company also plans the construction of a roundhouse and machine shop at Ironton, Ohio.

GALVESTON, HARRISBURG & SAN ANTONIO-SOUTHERN PACIFIC.—This company will construct an addition to its engine terminal at San Antonio, Tex., with the company forces at a cost of $80,000, including boiler washing plant and enlargement of roundhouse by the construction of three additional engine stalls and the extension of the existing six stalls, 47 ft.

ATCHISON, TOPEKA & SANTA FE.—This company has authorized the construction in 1924 of the following units in expansion of the terminal facilities at San Bernardino, Cal.: A boiler shop with tank shop and stripping pit, 600 ft. by 160 ft., to cost $900,000, with mechanical equipment; extension of erecting bay of locomotive shop; installation of a new transfer table; extension of the present machine shop, 200 ft. by 196 ft. Of the appropriation of $2,800,000, $600,000 will be spent this year. A contract has been awarded to Joseph E. Nelson & Son, Chicago, for the construction of an apprentice school building at San Bernardino, Cal., to cost $30,000.

BALTIMORE & OHIO.—This company has awarded a contract to the American Water Softener Company, Philadelphia, for water softener equipment in treating plants at North Dayton, Ohio, Troy, Old River Junction, Lima, Deshler, Rosford and Fairmount, W. Va. The contract for the construction of buildings, tank foundations and the installation of piping and all machinery at Troy, Old River Junction, Lima, Deshler and Rosford has been awarded to Joseph E. Nelson & Sons Company, Chicago. Contracts have also been awarded to the Pittsburgh-Des Moines Steel Company, Pittsburgh, Pa., for the construction of water treating plants at Tontogany, Ohio, Wapakoneta, Ohio, and Twin Creek, Ohio.

ILLINOIS CENTRAL.—This company has prepared plans for the construction of additions to its shops and yards at Evansville, Ind., to cost approximately $1,000,000, and has awarded contracts to the Drumm Construction Company, Chicago, for the construction of a concrete pit and scale house at Harahan, La., and to the Howlett Construction Company for the construction of a 300-ton reinforced concrete coaling station at Gilman, Ill., and a contract to Joseph E. Nelson & Sons, Chicago, for the construction of a water treating plant and pumping station at Powderly, Ky. The company also plans the construction of a locomotive shop, roundhouse and oil station at Sioux City, Iowa, to cost approximately $500,000.

PERSONAL MENTION

General

F. T. Quinlan has been appointed engineer of tests of the New York, New Haven & Hartford, with headquarters at New Haven, Conn.

C. L. PETERSON has been appointed general supervisor of power stations of the New York, New Haven & Hartford, with headquarters at New Haven, Conn.

F. E. Ballda has been appointed assistant to the mechanical manager of the New York, New Haven & Hartford, with headquarters at New Haven, Conn.

H. P. HASS has been appointed office assistant to the mechanical manager of the New York, New Haven & Hartford, with headquarters at New Haven, Conn.

R. W. HUNT has been appointed fuel supervisor of the Atchison, Topeka & Santa Fe, Coast lines and the Grand Canyon Railway, with headquarters at Los Angeles, Cal.

W. B. SHELTON, motive power inspector of the Altoona works of the Pennsylvania System, has been appointed motive power inspector of the Monongahela division, with headquarters at Uniontown, Pa.

SILAS D. ZWIGHT, whose appointment as general mechanical superintendent of the Northern Pacific with headquarters at St. Paul, Minn., was announced in the December issue of the *Railway Mechanical Engineer*, was born on May 23, 1867, at LaCrosse, Wis. He attended elementary school and business college and entered railway service in May, 1866, on the Chicago, Burlington & Quincy. In June, 1888, he entered the service of the Northern Pacific as a locomotive fireman on the Dakota division and has since remained continuously in the service of the Northern Pacific. He was later promoted successively to locomotive engineer, road foreman of engines, master mechanic, general master mechanic, assistant to the mechanical superintendent, mechanical superintendent and acting general mechanical superintendent, which position he held at the time of his recent promotion to general mechanical superintendent.

S. D. Zwight

E. GELZER has been appointed mechanical engineer of the Chicago, Great Western, with headquarters at Oelwein, Iowa. Mr. Gelzer was born in London, England, and educated in the Berlin Polytechnic Institute, Berlin, Germany. He served his apprenticeship with the Borsig Locomotive Works and the Blackhead Locomotive Works, Berlin, and in 1915 entered the employ of the Bethlehem Steel Company as a designer of machinery. He then became a designer of locomotives and enginehouse equipment on the Pennsylvania and subsequently served as enginehouse foreman at Fort Wayne, Ind., and motive power inspector, North Western region. In 1921 he entered the employ of the Illinois Central as leading draftsman, locomotive department. During the war he was with the 13th Engineers in France and later attached to the Interallied Commission for the inspection of German material. Mr. Gelzer is a member of the American Society of Mechanical Engineers and the American Association of Engineers.

J. C. McCULLOUGH has been promoted to assistant to the general manager of the Central region of the Pennsylvania with headquarters at Pittsburgh, Pa., Mr. McCullough was born on August

31, 1865, at Deersville, Ohio. He entered railway service on September 9, 1881, as a shop laborer on the Pittsburgh, Cincinnati, Chicago & St. Louis, now a part of the Pennsylvania, at Dennison, Ohio. Two years later he was promoted to machinist's helper and in 1884 to locomotive fireman. From 1887 to 1898 he served as locomotive engineer and on April 1 of the latter year was promoted to assistant road foreman of engines. On January 1, 1901, he was promoted to road foreman of engines, a year later being promoted to trainmaster. On March 1, 1910, Mr. McCullough was promoted to division superintendent and on April 16, 1919, to general superintendent of the Eastern Ohio division of the Central region with headquarters at Pittsburgh, Pa. He was serving in this capacity at the time of his recent promotion to assistant to the general manager of the Central region.

WILLIAM L. BEAN has been promoted to assistant mechanical manager of the New York, New Haven & Hartford. Mr. Bean was born on January 3, 1878, and was graduated from the University of Minnesota in 1902, having completed the course in mechanical engineering. He immediately entered the service of the Northern Pacific as a special apprentice and served in that capacity until late in 1904. On January 1, 1905, he became a gang foreman for the Atchison, Topeka & Santa Fe. In 1906 he was promoted to locomotive inspector and in 1908 to machine shop foreman. The following year he became division foreman and a few months later motive power assistant. In 1911 he was appointed bonus supervisor and held that position until early in 1912. Mr. Bean was out of railroad service then until July, 1916, when he entered the service of the New York, New Haven & Hartford as an analyst in expenses and methods. In 1917 he was promoted to assistant to the chief mechanical superintendent and in 1918 to mechanical assistant, which position he held at the time of his recent promotion.

W. L. Bean

B. B. MILNER has been appointed mechanical engineer of the Missouri-Kansas-Texas with headquarters at Parsons, Kan. Mr. Milner was born on November 5, 1881, at Hartford, Kan. In 1899-1900 he worked in the Parsons shops of the Missouri-Kansas-Texas, and then entered Purdue University, from the mechanical engineering school of which institution he was graduated in 1904. Thereupon he entered the service of the Pennsylvania as a special apprentice at Altoona Works. He later worked in the test department and on special investigations. In 1908 he entered the office of the general manager at Philadelphia to engage in various betterment studies. In 1911 he was appointed assistant master mechanic of the company's subsidiary, the Philadelphia, Baltimore & Washington. In 1913 he was appointed special engineer on the staff of the senior vice-president of the New York Central. He was subsequently appointed engineer of motive power and during the regime of the Railroad Administration acted as chief mechanical engineer. At the termination of federal control he was appointed engineer of motive power and rolling stock. In 1920 he joined the staff of Sale & Frazer, Ltd., Tokyo, Japan, and later practiced in a private capacity as a consulting engineer in that city. Lately Mr. Milner has been practicing as a consulting engineer in New York.

B. B. Milner

P. L. GROVE has been promoted to general superintendent of the Michigan division of the Pennsylvania, with headquarters at Grand Rapids, Mich. Mr. Grove was born on October 3, 1878, at Altoona, Pa. He entered railway service on May 1, 1894, as a messenger in the Altoona shops of the Pennsylvania and two years later was promoted to machinist apprentice. In 1899, he was promoted to machinist on special assignments, being promoted to inspector at the Columbia shops of the Philadelphia division in February, 1902. Mr. Grove was promoted to foreman of the State Line shops of the Bedford division in October, 1904, and in July, 1905, was again promoted to assistant master mechanic of the Altoona machine shop. He was promoted to assistant engineer of motive power of the Northern division, with headquarters at Buffalo, N. Y., in September, 1910. In September, 1917, he was promoted to superintendent of the Delaware division of the Philadelphia, Baltimore & Washington with headquarters at Wilmington, Delaware, and in February, 1920, was transferred to the New York division, with headquarters at Jersey City, N. J., which position he was holding at the time of his recent promotion.

P. L. Grove

Master Mechanics and Road Foremen

C. C. HAMILTON has been appointed master mechanic of the Canton Railroad, Baltimore, Md.

G. W. CUYLER, master mechanic of the Chicago, Rock Island & Pacific at Herington, Kan., has been transferred to Horton, Kan.

SAMUEL RUSSELL has been appointed division master mechanic of the Boston & Albany, with headquarters at West Springfield, Mass.

W. E. SCOTT has been appointed assistant road foreman of engines of the Seaboard Air Line with headquarters at Hamlet, N. C.

J. U. HOWIE has been appointed assistant road foreman of engines of the Seaboard Air Line with headquarters at Howells, Ga.

A. E. MCMILLAN, master mechanic of the Baltimore & Ohio at Dayton, Ohio, has been appointed district master mechanic with headquarters at Wheeling, W. Va.

T. W. MCCARTLEY, master mechanic of the Chicago, Rock Island & Pacific at Horton, Kan., has been transferred to Cedar Rapids, Iowa, succeeding C. B. Daily, promoted.

T. C. O'BRIEN, general foreman of the Baltimore & Ohio at Lima, Ohio, has been promoted to master mechanic of the Toledo division, with headquarters at Dayton, Ohio.

Car Department

T. R. WILLIAMS has been appointed assistant to the master car builder of the Northern Pacific, with headquarters at St. Paul, Minn.

J. B. GILLUM has been appointed car foreman of the Baltimore & Ohio at Keyser, W. Va., succeeding O. G. Stanley who has been promoted.

D. L. WINKLEPLECK has been appointed assistant general car foreman, and A. E. Tufts and W. S. McClung, assistant car foremen of the Chicago, Rock Island & Pacific, with headquarters at Cedar Rapids, Iowa.

Shop and Enginehouse

O. G. STANLEY has been promoted to superintendent of shops of the Baltimore & Ohio, with headquarters at Keyser, W. Va.

J. R. LANCASTER has been appointed superintendent of the Scranton, Pa., locomotive shops of the Delaware, Lackawanna & Western.

A. W. MILLER, general locomotive foreman of the Washington shops of the Baltimore & Ohio, has been transferred as general foreman to Lima, Ohio.

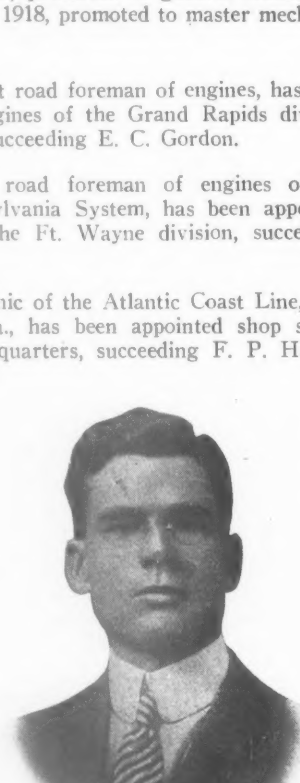
CHARLES S. TAYLOR, master mechanic of the Atlantic Coast Line, with headquarters at Wilmington, N. C., has been appointed shop superintendent of the Emerson shops, with headquarters at Rocky Mount, N. C. Mr. Taylor was born on January 7, 1886, at Wilmington, N. C. He is a graduate of grammar school and of McGuire's, Richmond, Va. He entered the employ of the Atlantic Coast Line on August 26, 1902, as a machinist apprentice. From September 4, 1906, until June 1, 1909, he served as a machinist, on the latter date being promoted to roundhouse foreman, with headquarters at Rocky Mount. On October 1, 1909, he was transferred as foreman to Richmond, Va.; January 1, 1911, transferred to Florence, S. C., as roundhouse foreman; March 18, 1912, promoted to general foreman at Wilmington, and on January 1, 1918, promoted to master mechanic, as above noted.

Charles S. Taylor

F. G. CASLER, acting assistant road foreman of engines, has been appointed road foreman of engines of the Grand Rapids division of the Pennsylvania System, succeeding E. C. Gordon.

E. A. BURCHIEL, assistant road foreman of engines of the Toledo division of the Pennsylvania System, has been appointed road foreman of engines of the Ft. Wayne division, succeeding O. E. Maxwell.

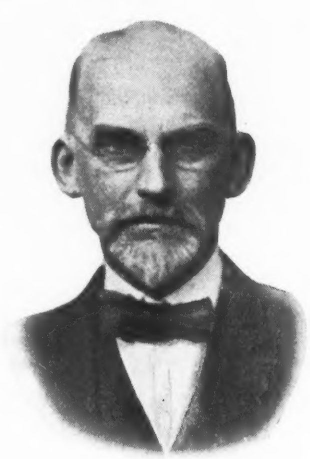
C. A. WHITE, master mechanic of the Atlantic Coast Line, with headquarters at Waycross, Ga., has been appointed shop superintendent, with the same headquarters, succeeding F. P. Howell. Mr. White was born at Montgomery, Ala., March 12, 1887. From September, 1904, to November, 1908, he was a machinist apprentice on the Atlantic Coast Line, subsequently serving as a machinist on the Missouri-Pacific at Little Rock, Ark.; the Southern at Selma, Ala.; the Mobile & Ohio at Tuscaloosa, Ala.; the Atlantic Coast Line at Waycross; and the Central of Georgia at Columbus, Ga. In September, 1909, he returned to the Atlantic Coast Line, serving as a machinist at Montgomery until October, 1910, when he was promoted to erecting shop foreman. In July, 1914, he became day roundhouse foreman, and in February, 1920, was transferred to Charleston, S. C., as general foreman. In March, 1921, he was promoted to master mechanic, with headquarters at Waycross.



C. A. White

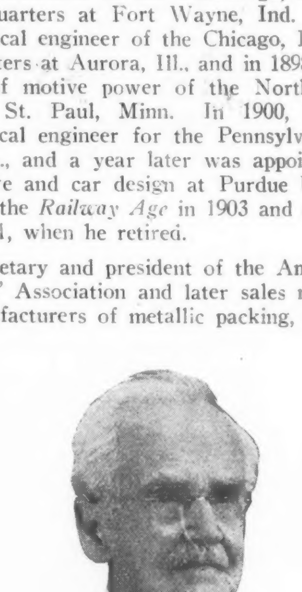
Obituary

WILLIAM FORSYTH, formerly superintendent of motive power of the Northern Pacific and later mechanical engineering editor of the Railway Age and associate editor of its successor, the Railway Age Gazette, died at Chestnut Hill, Pa., on December 3. Mr. Forsyth was born on July 2, 1852, at Northumberland, Pa., and attended the Polytechnic College of Pennsylvania at Philadelphia from 1868 to 1870. He entered railway service in the latter year as a machinist apprentice on the Philadelphia & Reading. In 1874 he was employed by the Altoona Iron Company at Altoona, Pa., and a year later he entered the test department of the Pennsylvania at Altoona. Mr. Forsyth remained on this work until 1881 when he was appointed assistant master mechanic of the Pittsburgh, Fort Wayne & Chicago, with headquarters at Fort Wayne, Ind. In 1882, he was appointed mechanical engineer of the Chicago, Burlington & Quincy with headquarters at Aurora, Ill., and in 1898 he was appointed superintendent of motive power of the Northern Pacific, with headquarters at St. Paul, Minn. In 1900, Mr. Forsyth was appointed mechanical engineer for the Pennsylvania Coal Company at Scranton, Pa., and a year later was appointed associate professor of locomotive and car design at Purdue University. He joined the staff of the *Railway Age* in 1903 and continued in this capacity until 1911, when he retired.



William Forsyth

J. H SETCHEL, formerly secretary and president of the American Railway Master Mechanics' Association and later sales manager of Jerome & Elliott, manufacturers of metallic packing, died on December 13 at Cuba, N. Y. He was born on December 25, 1835, at South Bainbridge, Chenango county, New York, and in early life entered railroad service with the Galena & Chicago Union Railroad in its roundhouse. Soon after, he served a two-year apprenticeship as machinist with the Detroit Novelty Works at Detroit, Mich., and for several years following was a machinist and locomotive engineer on the Ohio & Mississippi. Subsequently until the breaking out of the Civil War, he was a locomotive engineer on the Louisville & Nashville. During the first year of the war he was a foreman at Nashville, Tenn., and from 1862 to 1868 he was a locomotive engineer on the Little Miami Railroad. During the latter year he was promoted to assistant master mechanic in charge of the shops at Columbus, Ohio, which position he held until 1873, when he became superintendent of the Kentucky Central. From 1874 to 1885 he was general master mechanic of the Ohio & Mississippi and in the latter year he resigned to become superintendent of the Brooks Locomotive Works, which position he held for three and one-half years, when he entered the employ of the Pittsburgh Locomotive Works as general traveling agent. In November, 1902, he was appointed western representative and traveling agent for the American Locomotive Company with headquarters at Chicago, which position he held until October 1, 1903, when he became general sales manager for Jerome & Elliott.



J. H. Setchel